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Global change and sustainable development: critical trends

Report of the Secretary-General

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I. DEVELOPMENT AND ENVIRONMENT: FROM STOCKHOLM TO RIO

Introduction

1. The past 25 years have witnessed major changes in the way the issues of economic growth, human development and environmental protection are approached. Two international conferences serve as landmarks. The United Nations Conference on the Human Environment, held at Stockholm in 1972, was the first major discussion of environmental issues at the international level. The agenda was immense, touching on virtually all aspects of natural resource use, but the focus (reflecting the concerns of the developed countries which proposed the Conference) was on the threat to the natural environment posed by economic growth and industrial pollution. Developing countries, for whom these problems were still largely irrelevant, argued that poverty posed a greater threat to both human welfare and the environment, and that economic growth in their case was not the problem but the solution. Stockholm thus marked a polarization between the priorities of economic growth and environmental protection which has dominated the debate between rich and poor countries, and between interest groups within countries, for many years and is still not fully resolved.

2. During the 1980s, a new political and developmental paradigm emerged which appeared to reconcile these conflicting objectives. In 1987, the World Commission on Environment and Development published its report Our Common Future, better known as the Brundtland Report. The report set out the concept of "sustainable development", an integrated approach to policy- and decision-making in which environmental protection and long-term economic growth are seen not as incompatible but as complementary, indeed mutually dependent: solving environmental problems requires resources which only economic growth can provide, while economic growth will falter if human health and natural resources are damaged by environmental degradation.

3. Publication of the Brundtland Report set in motion a process which culminated in the United Nations Conference on Environment and Development (UNCED), held at Rio de Janeiro in 1992. A comparison of the action plans produced by the Stockholm and Rio Conferences illustrates a major shift in our understanding of, and approach to, the problems of long-term human development. Where Stockholm adopted an issue-oriented approach to pollution and non-renewable resource depletion, Rio emphasized integrated strategies to promote human development through economic growth based on sustainable management of the natural resource base. The UNCED action plan, Agenda 21, thus reaffirmed the Brundtland Report's central message: socio-economic development and environmental protection are intimately linked and effective policy-making must tackle them together.

4. This complex agenda, and the message of policy integration, have become widely accepted in the years since Rio, though integration remains a difficult concept to implement. Policy objectives in key areas can and do conflict and means of reconciling different interests and achieving acceptable trade-offs remain underdeveloped. The challenge facing policy makers over the coming years will be to identify critical issues in domestic and international development,

and to prioritize measures according to the severity of the problem and the time required for policy to take effect.

Critical trends, past and future ...

5. The present report examines some critical issues of sustainable development, reviewing developments over the past 25 years and looking into the future with the help of model-based projections and scenarios (see box 1). The issues under consideration have been chosen to reflect the widely accepted "pressure-state-response" framework used in much integrated environmental analysis. Population growth (chap. II) in recent decades has increased the overall pressure on the natural resource base. However, greater environmental pressure appears to be exerted by the level and patterns of production and consumption of modern industrial economies. Agenda 21 states that energy and materials use (chap. III) in the developed world is the leading cause of global environmental degradation. The consequences of recent trends in population growth and consumption are potentially most serious when they lead to damage to the natural resources of land (chap. IV) and water (chap. V). Land supports the livelihood of over half the world's population and provides most of the global food supply. Fresh water is indispensable to all life forms and is an essential input to economic activity, especially agriculture. Society's response to trends in these key issues, and their interactions, may be measured in terms of human development (chap. VI) - that is, the extent to which people enjoy adequate income, health, education and other, more intangible, goods such as freedom of choice and personal dignity.

... and the role of policy

6. The focus throughout the report is on the role of policy. To what extent have trends in economic growth, consumption patterns and environmental degradation been influenced by policy intervention? Which policies have proved beneficial and which detrimental? Given the lessons of the past, and the likely shape of things to come (based on the best available projections), what appear to be the most urgent priorities in different regions of the world, and the most promising policy approaches?

7. Any evaluation of trends and the role of policy must take account of the constraints under which Governments operate. The world is becoming increasingly integrated in its commercial and financial activities, while modern means of travel and communications are breaking down many of the traditional physical and cultural barriers between States. National Governments have little control over the forces of globalization and it seems likely that new international bodies, or institutional reforms, will be required to deal with emerging global issues in the future. However, many of the most pressing developmental and environmental problems today are felt at local or national levels. While international action will often be part of the long-term solution, there remains great scope for short- and medium-term policy action at the national level. Accordingly, this report focuses primarily on the potential for effecting change through domestic policy measures.

8. An additional, and powerful, constraint on policy intervention to influence trends is the factor of time: different issues have their natural "pace of change" which becomes apparent when examined over a time-span of 50 years or more. Population programmes, by definition, take at least one generation to take effect. Action to combat pollution can sometimes improve local air or surface-water quality within a few years. Soil degradation and deforestation may be reversed only after decades of sustained effort, while contamination of groundwater reserves might never be corrected, necessitating the use of permanent and costly purification techniques. For these reasons, most problems of environmental degradation require long-term planning and consistent policy-making over many years. By contrast, economic and social problems may sometimes be remedied relatively quickly through targeted policy measures. Additionally, technologies and social behaviour patterns can change rapidly and, while these areas are not readily susceptible to government direction, they represent powerful agents of change and potential cause for optimism.

Global change and the concept of transitions

9. Economic growth, social development and natural resource use are interrelated in ways which, though not fixed, display certain patterns. One way of viewing these linkages over time is through the concept of transitions.

10. A transition may be defined as a gradual, continuous shift in society from one "mode of operation" to another - for example, from an agricultural to an industrial economic base. Four important phases in a transition can usually be described: (i) a pre-development phase of equilibrium and little change; (ii) a take-off phase, which may be hard to initiate through conscious policy effort; (iii) an acceleration phase, characterized by instability due to rapid technological, social and environmental change; societies and environmental quality are highly vulnerable to damage during this stage; and (iv) a stabilization phase, in which the pace of change slows and a new form of equilibrium is reached (the best-known example of this process is the demographic transition, which is summarized in chap. II).

11. This report describes trends in population growth, socio-economic development and the environment as a family of transitions. Clearly there are limitations and shortcomings in this approach but it may represent a promising and useful way of visualizing global change. It is important to note that transitions are not a law of nature; they do not determine what must inevitably happen. Rather, they represent development pathways which have already been experienced by a number of countries and which provide insight into a range of likely futures, dependent on economic, social and environmental circumstances. From the policy maker's point of view, the importance of transitions is that their magnitude, and rate of change, can be significantly influenced by policy intervention.

Taking stock, moving forward

12. Looking back over developments of the past 25 years, one clear lesson to be learned from projections made in the 1970s (most famously, in the 1972 report of

the Club of Rome, Limits to Growth) is that dogmatic predictions regarding the Earth's future are unreliable and can be politically counter-productive. With hindsight, world developments since then can be characterized as more complicated, more surprising and, generally, more positive than anticipated. Many problems identified in earlier "doom scenarios" persist but they have not overwhelmed the planet. Some threats - nuclear war, fossil fuel exhaustion - have receded; others - population pressure, industrial pollution - have shown themselves susceptible to determined policy intervention. Less happily, new and unexpected threats have emerged - life-threatening damage to the stratospheric ozone layer, the resurgence of infectious diseases, the rise of AIDS, anticipated changes in the global climate. In sum, while millions of people enjoy lives of safety and comfort unimaginable a few generations ago, hundreds of millions more live in conditions as bad as any endured in the past.

13. The current outlook is uncertain, but prudent policy-making must involve some anticipation of events and the future is not entirely a black box. We have improved our understanding of the interactions between economic, social and environmental systems and have a greater appreciation of uncertainty and risk management. Forecasting is therefore a less deterministic science than 25 years ago. Scenarios no longer predict; they paint pictures of possible futures and explore the different outcomes that might result if basic assumptions are changed, for example, regarding policy interventions.

14. Currently, some trends appear positive: the growth in world population is slowing, food production is still rising, the majority of people are living longer and healthier lives, environmental quality in some regions is improving. But it is impossible to ignore other trends which have the potential to undermine these gains or even bring about catastrophic collapse of local economies. They include the growing scarcity of fresh water, loss of productive agricultural land and the downward spiral of impoverishment affecting a significant minority of the world's population. These threats are real and near-term; they already affect millions of people.

15. The present thus emerges as a time of tension between positive and negative forces - with the balance liable to tip in different directions in different regions of the world. Global catastrophe does not appear to be imminent. But projections cited in this report clearly indicate that pursuit of business-as-usual development patterns is most unlikely to result in sustainable development in the near future. That is, on current trends, we appear unlikely to achieve a desirable balance of economic growth, equitable human development and healthy, productive ecosystems.

16. Economic growth remains the primary policy objective in most countries, on the assumption that other desirable objectives - social and environmental improvement - will follow in its wake. Historically, this has been the case in the industrialized countries - given sufficient time, and making a major exception for their irreversible losses of natural habitat and biodiversity. These historical economic, social and environmental transitions will not be replayed exactly in developing countries. Today, the pace and scale of change are greater, geopolitical, macroeconomic, geographical and cultural circumstances are different. Some developing countries appear to have weathered a half-century of extraordinarily rapid change and emerged with strong economies

and thriving populations. The environmental cost has often been high but may be repairable over time. A number of poorer developing countries have yet to undergo the transformations which are essential to function in the modern global economy. More critically, some face the prospect of losing much of their natural capital before alternative sources of employment and wealth generation are sufficiently developed.

17. The following chapters outline past trends and future prospects in some of these critical issues and seek to identify some of the key challenges and options for action which will confront policy makers over the next decade and more. History shows that many negative trends can be reversed given agreement on clear objectives.

Looking ahead: the conventional development scenario

The present report takes as its reference scenario the Conventional Development Scenario (CDS) developed by the Stockholm Environment Institute. This Scenario is also used in the recent United Nations Environment Programme (UNEP) report, Global Environmental Outlook (GEO I). CDS forms the basis for a "what if?" model-based analysis and is not meant to represent a desirable or highly probable future. It assumes a continued evolution of the processes which have shaped economic, social and environmental developments so far: economic growth and wealth allocation driven by public and private investments, free markets and competition; rapid industrialization and urbanization; material accumulation and individualism as the prime motives of human behaviour; and the nation State and liberal democracy as the dominant form of governance in the modern era. These processes are foreseen as continuing within the larger context of global trends: widening and deepening of the information revolution; homogenization of culture; some convergence of developing countries' economies; and increasing economic dominance of multinational corporations. CDS assumes no major additional policy interventions and does not build in any major social, technological or natural disruptions or surprises.

Demographic, economic and energy assumptions are based on the mid-range Intergovernmental Panel on Climate Change (IPCC) non-intervention IS92a scenario. CDS is supplemented with assumptions for water and land use and food intake, which were not taken into account in the IPCC scenario. CDS does not take account of major social indicators (culture, institutions, education, quality of life), which is a serious omission but one that current models are not yet equipped to address.

II. TRENDS IN WORLD POPULATION

Introduction

18. The 1972 Stockholm Conference took place at the end of two decades in which the world's population soared from 2.5 billion to 3.7 billion - the most rapid growth rate in human numbers ever experienced. Population doubling times for some developing countries were falling below 20 years and some scientists and policy makers in developed countries expressed fears that "the population explosion", if not controlled through vigorous population programmes, would lead to mass starvation and societal breakdown. This view was largely rejected by the Governments of developing countries, and the population issue proved too sensitive even to be included in the Stockholm agenda.

19. Subsequent international population conferences (Bucharest 1974, Mexico 1984 and Cairo 1994) charted the gradual emergence of a more consensual approach to the population issue. By the early 1980s, the "North" had largely accepted the "Southern" argument that population policies should be set more broadly in the context of socio-economic development. Concerns over possible environmental limits to population growth (focusing successively on deforestation, energy, water and climate change) were increasingly debated in scientific and policy communities. These linkages between population and environment slowly became more prominent at the international level: Our Common Future (1987) and Agenda 21 (1992) both explicitly discussed population issues in relation to sustainable development.

20. In 25 years, the population debate has evolved dramatically from a narrow focus on population size and growth rates to a more integrated agenda embracing demographic structures, distribution patterns and urbanization, levels of exploitation of natural resources, and creation of viable agricultural and industrial infrastructures. Policy makers increasingly acknowledge these interlinkages between demographics, environment and economy. At the same time, there is still heated controversy over whether the world's population is on an unsustainable trajectory or not; population data invite conflicting interpretations. The following section explores some key aspects of the global demographic transition and their implications for future policy intervention.

The demographic transition

21. The demographic transition is the most widely observed and documented example of the transition concept. Initially, during the pre-development phase, birth and death rates are high and in equilibrium with each other, resulting in slow or no population growth. In the take-off and acceleration phases, the average death rate falls, primarily due to improved health care, the average birth rate remains high and the population grows rapidly. In the stabilization phase, the dominant determinant is a decline in birth rates. In a complete transition, birth rates fall to match the reduction in death rates and a new stable, though much higher, population size is achieved. However, if death rates decrease but birth rates fail to decline to the same extent, the transition "stalls" and total population size continues to increase.

22. As of 1997, the demographic transition has become a historical fact in approximately 30 countries of the world, including all the larger industrialized countries of Europe and Japan. With high life expectancies and growth rates fluctuating around 0.4 per cent a year, their populations are effectively stable. A small number of European countries have negative growth rates and population dynamics in Eastern Europe and the former Soviet Union have been strongly affected by the political and economic transformations experienced since the late 1980s. Fertility rates in the region between 1990 and 1995 were 23 per cent lower than in the previous five-year period. At the same time, mortality rates rose; for example, the average life expectancy of males in the Russian Federation fell sharply, from 65 in 1987 to 57 in 1994.[1] A more varied picture emerges in other regions of the world where population levels are generally rising. However, falling fertility rates are already powerfully evident in Latin America and some parts of Asia. Sub-Saharan Africa has yet to complete the fertility transition, though fertility rates appear to have begun to decline in a number of countries, for example, Madagascar, the United Republic of Tanzania, Namibia, South Africa and Mauritania. For developing countries as a whole, fertility rates are falling rapidly (figure II.1).

23. Overall, the annual growth rate in the world's population has declined from a high of just over 2 per cent in the 1960s to 1.48 per cent in the decade beginning in 1990. The number of people added to the world's population each year (the annual increment) has risen steadily from 47 million in 1950, but is now thought to have peaked at around 81 million in 1995, with population stabilization (an annual increment of 0) expected in 2050.[2] The population growth rate has fallen more swiftly than demographers expected, because of a faster fertility decline than was previously anticipated. The most recent (1996) United Nations population projections show a significant downward revision of both estimated historical population growth and the size of the world's future population (figure II.2).

24. The combination of declining fertility and accelerating population growth is, in part, the result of previously accumulated "demographic potential", that is, high numbers of young people who are now entering reproductive age. High fertility levels also persist in some parts of the world. Even if fertility rates everywhere were to fall instantly to replacement level (2.06 children per woman), the high proportion of young people "in the pipeline" ensures that world population growth will not be halted for another two generations.[3]

Figure II.1

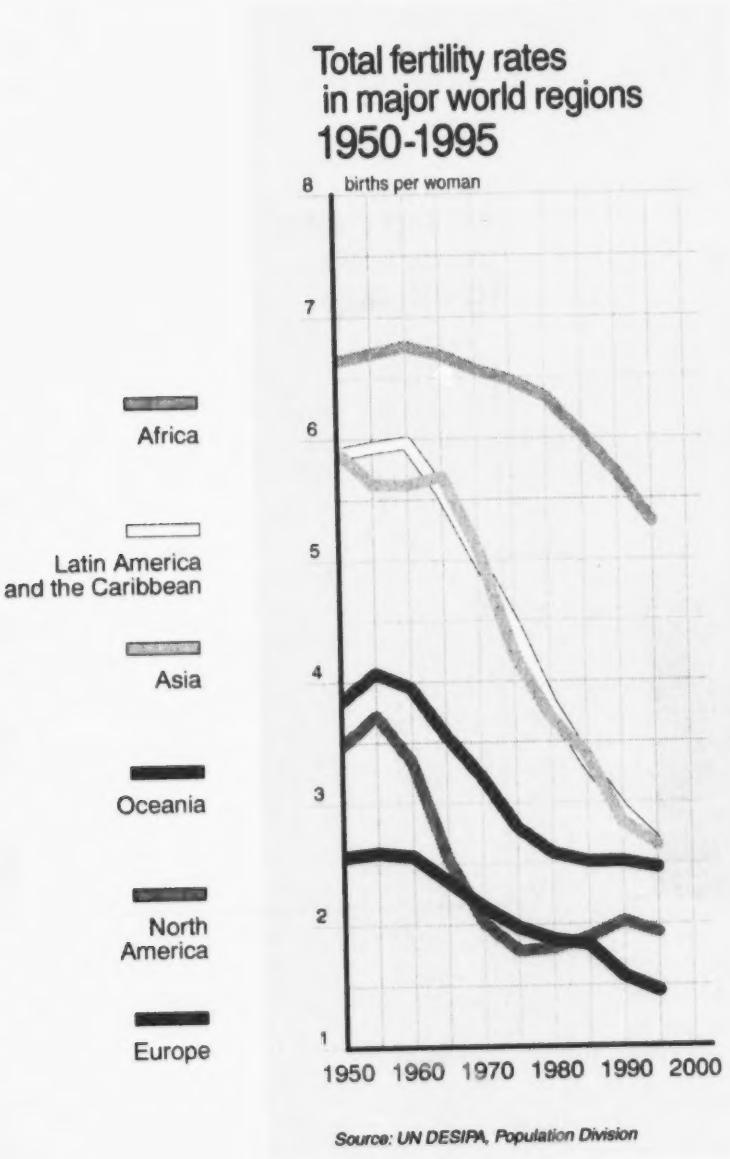
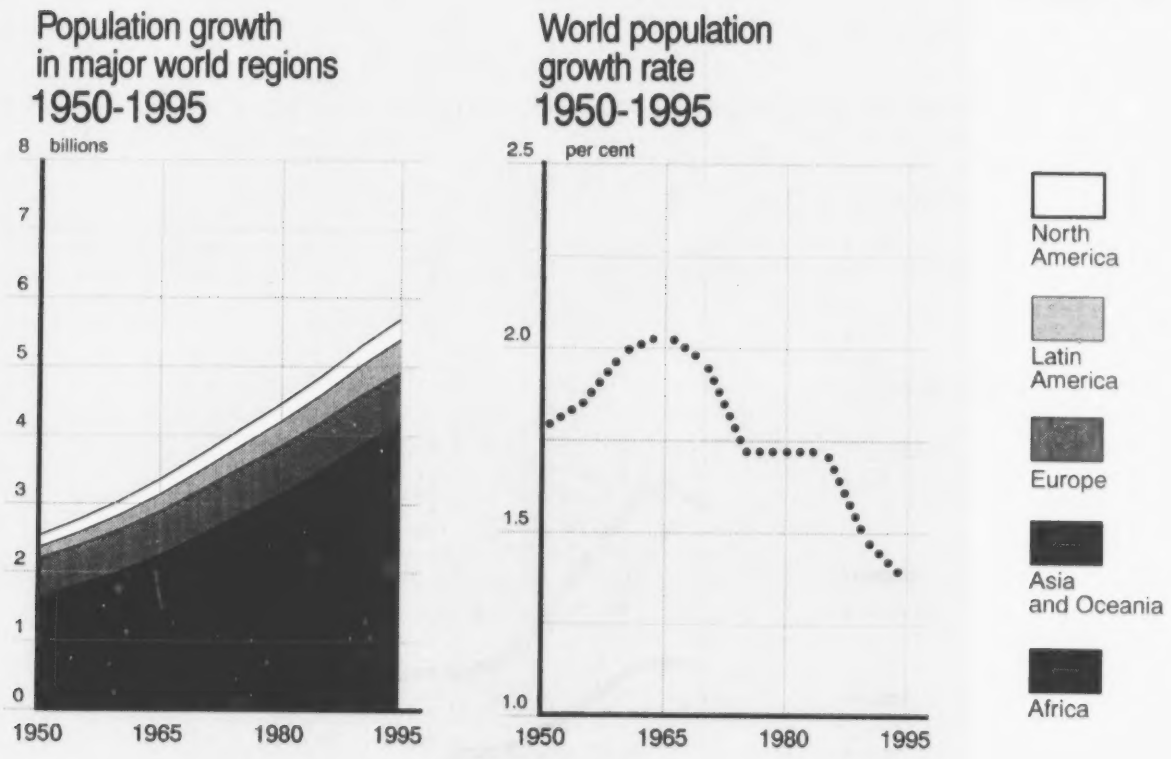

Total fertility rates
in major world regions
1950-1995
births per woman
8
7
6
5
4
3
2
1
1950 1960 1970 1980 1990 2000
Africa
Latin America and the Caribbean
Asia
Oceania
North America
Europe
Source: UN DESIPA, Population Division

Figure II.2

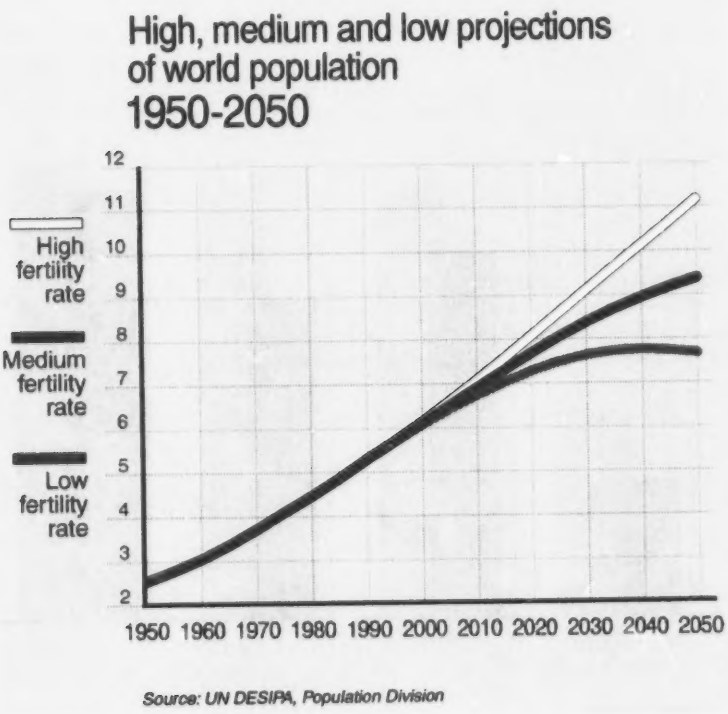


Source: UN DESIPA, Population Division

Looking ahead

25. The Conventional Development Scenario (CDS) assumes that developing countries will complete the demographic transition. CDS uses median range projections produced by the United Nations and World Bank which depend primarily on assumed future fertility and mortality rates. By 2050, CDS projects a world population of 10 billion people, with 95 per cent of growth occurring in the developing world.[4] Total fertility rate in developing countries is expected to reach replacement level in the mid-twenty-first century. The world population is projected to continue increasing slowly to about 11 billion. However, even slight variations in fertility rates could have enormous consequences. The high and low United Nations population estimates differ by 4 billion people, a huge difference, but one that is accounted for by a difference in average fertility rates of just one child per woman (figure II.3).

Figure II.3



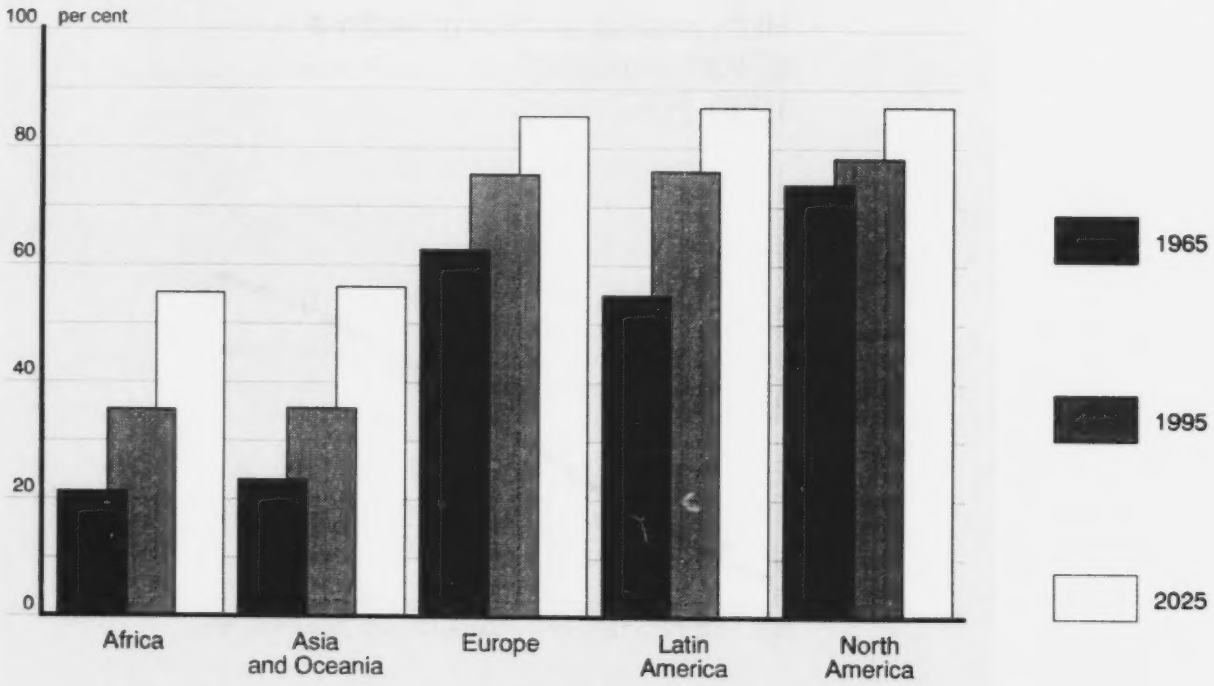
Source: UN DESIPA, Population Division

Urbanization

26. The world has been steadily urbanizing for centuries. Waves of rapid urbanization have followed periods of economic growth in northern Europe and subsequently in the United States of America, Japan and industrializing countries in Asia and Latin America. Almost half the world's population is now urban and by about 2015 the majority - over 5 billion people - will live in urban settlements (see figure II.4).

Figure II.4

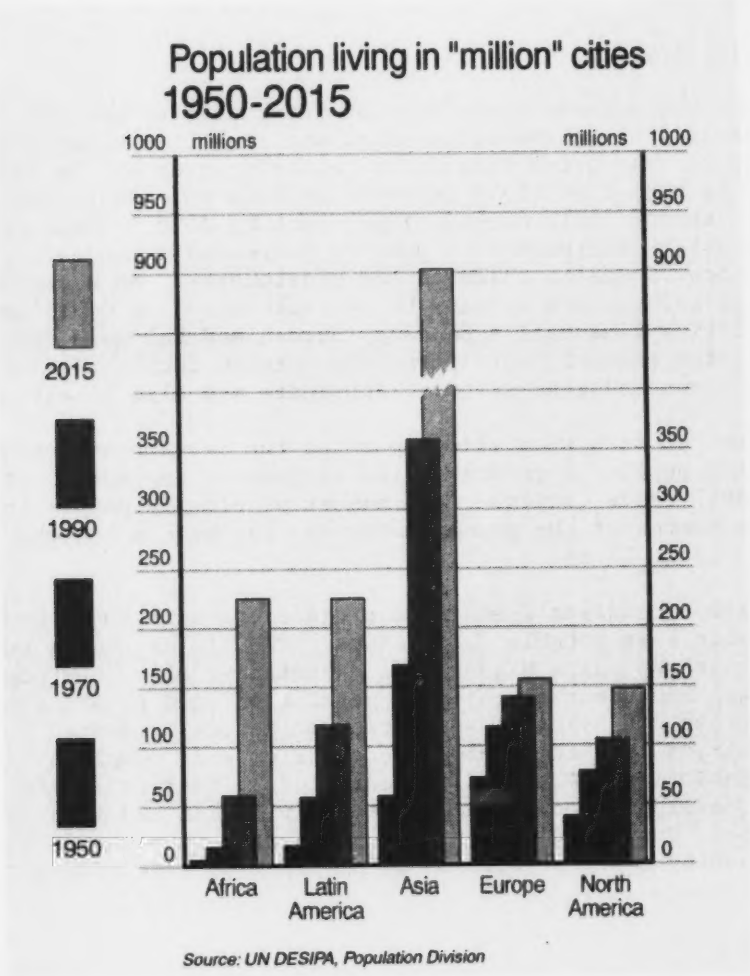
Population living in urban areas
1965-2025



Source: UN DESIPA, Population Division

27. Since 1970, most urban growth has taken place in developing countries, fuelled by both rural-urban migration and natural population increase. While developing countries' rates of urban growth are not unprecedented, their higher population base means that the scale of urbanization in developing countries today often dwarfs the experience of Europe or North America. Approximately 55 million people are now added to the urban population of developing countries every year; since 1970, the number of "million" cities (those with populations between 1 million and 10 million) in Africa, Asia and Latin America has more than doubled.[1] Even relatively slow rates of urban growth can translate into enormous increases in absolute numbers (see figure II.5).

Figure II.5



Source: UN DESIPA, Population Division

28. The rural-urban transition in some developing countries has departed from the path followed by the industrialized countries in another important respect: urbanization is occurring even in the absence of broad-based economic growth. The least developed countries are currently experiencing some of the highest urban growth rates; Africa has the highest urban growth rate of all world regions, at over 4 per cent per year.

29. Rapid urbanization in the late twentieth century thus appears to be characteristic both of the acceleration phase of economic transition (characterized by rising income and employment opportunities) and of failure to take off, that is, persistent poverty and social hardship in rural areas. In both cases, urban authorities will face mounting problems in providing adequate infrastructure, especially for impoverished slums and squatter settlements - which are now home to an estimated 25-30 per cent of urban inhabitants in developing countries.[5]

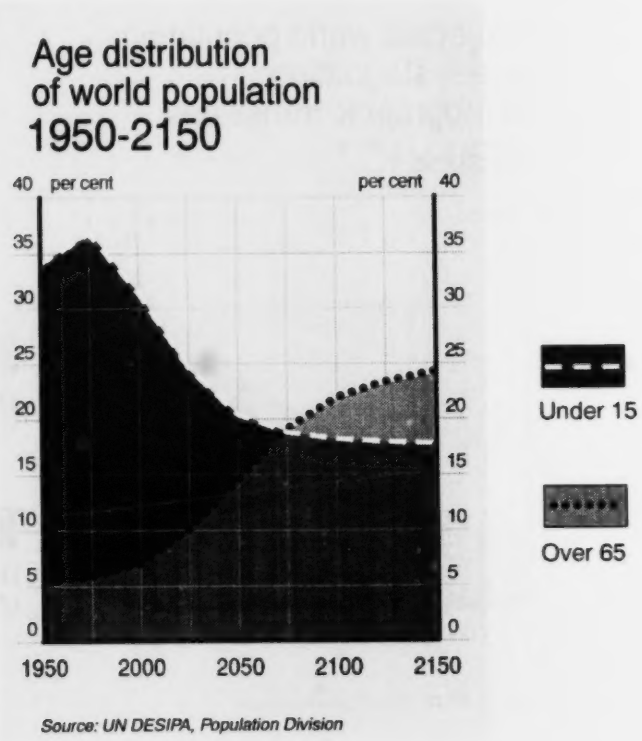
Changing age distribution

30. All current projections agree that an inevitable by-product of the demographic transition (to low birth rates and long life expectancy) is an ageing population. The proportion of the elderly (over 65) in developed countries rose from just nearly 8 per cent in 1950 to over 13 per cent today and, on current trends, will exceed 17 per cent by 2020.[2] This proportion of elderly people will contribute to a greatly increased dependency ratio (the ratio of the labour force to children and pensioners). As a consequence, difficult policy reforms are already being implemented in developed countries to address the shifting financial dependency burden and the need for changes in infrastructure (for example, more geriatric nursing facilities). Consumption patterns, employment and even cultural attitudes are also likely to be affected.

31. This phenomenon will soon affect much of the developing world, where the number of elderly people is growing twice as fast as the number of people of all ages. If present trends continue, the number of elderly people in the world will exceed the number of the young (below age 15) before the end of the twenty-first century (figure II.6).

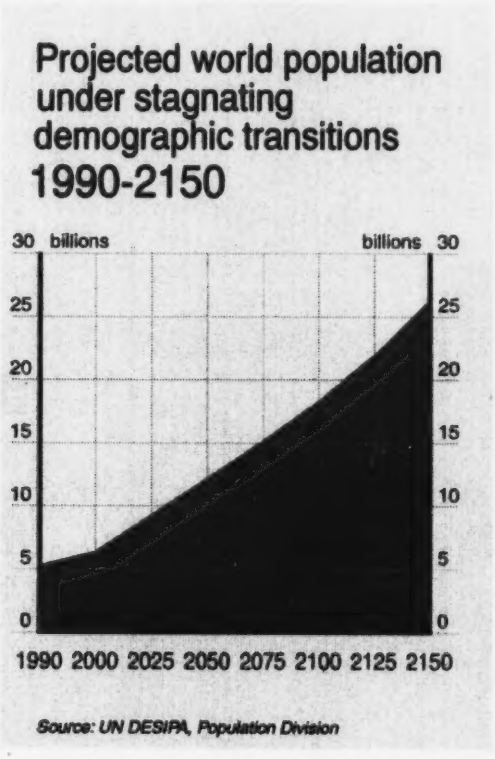
32. A comparison of current long-range projections with those undertaken a decade ago reveals some notable differences. CDS yields higher population numbers because it assumes a higher life expectancy; also, the population structure differs because the projected population aged 65 and over is about 25 per cent greater. A critical assumption in generally quoted future population scenarios is that developing countries will complete their demographic transitions. A very different picture emerges if, for example, the transitions in developing countries, especially Africa and South and East Asia, were to stagnate. Projections then show an ongoing increase in world population, reaching about 20 billion people in 2100 (see figure II.7).

Figure II.6



Source: UN DESIPA, Population Division

Figure II.7


Projected world population under stagnating demographic transitions
1990-2150
30 billions
billions 30
25
20
15
10
5
0
1990 2000 2025 2050 2075 2100 2125 2150
Developing countries
Developed countries
Source: UN DESIPA, Population Division

The role of policy

33. The demographic transition in industrialized countries has clearly been the result not of policy intervention but of development and modernization, which first brought about falling death rates (through improved education and health care) and then encouraged a change in public preferences regarding family size (as urbanization, increasing economic opportunity and security reduced the need for many children). It has often been pointed out that the demographic transition in many industrialized countries occurred in the context of rich resources and opportunities for expansion and colonization, allowing ample time and space for their populations to stabilize.

34. Given this history, many people in developing countries were at first hostile to calls for population control. However, a marked shift in attitude occurred following the 1974 World Population Conference. The number of developing countries regarding their fertility rates as too high rose from around 40 per cent to 67 per cent in the early 1990s and there was a corresponding rise in the number of Governments prepared to intervene to reduce fertility. By 1993, 53 per cent of developing countries had policies in place aimed at reducing their population growth rates.[6] This change was promoted, in part, by the difficulties of meeting the economic and social needs of escalating numbers of rural poor and the infrastructural problems presented by rapid, unplanned urbanization. Equally important, socio-economic development - rising levels of education, health programmes and community participation - fostered an environment more favourable to implementation of population programmes.

Steering the demographic transition

35. The causal mechanisms of demographic transitions are well, though not completely, understood. There is a general consensus among demographic experts that they include economic growth and rising per capita incomes, social "modernization" - a complex of factors including education, health care, rural-urban shifts, family structures and employment patterns (especially female labour force participation rates) - and population programmes focusing on family planning.[7]

36. The most rapid fertility declines have occurred in developing countries which have achieved major improvements in child survival rates and educational levels and have implemented family planning programmes. Within groups of countries at similar levels of development, fertility declines have generally been greatest in those with strong family planning programmes. In the absence of such programmes, economic development appears to induce fertility declines first among the more economically advanced population groups and only later across all groups.[8]

Demographic transitions and development pathways

37. The rate and manner in which countries pass through the demographic transition can be strongly influenced by development policies pursued by Governments. Some scholars have distinguished two main routes of development, one based on the introduction of advanced technologies and concentration on an urban, industrialized core, the other based on maximizing productivity of

whatever capital is available, usually beginning with the agriculture sector.[9] In the former case, modernization influences only a minority of the population and their falling fertility levels have a limited impact on the national birth rate. In the second case, broader-based economic development results in a majority of the population sharing in rising levels of income, education and health care, and a more rapid decline in total fertility rate. The speed and character of the demographic transition, in turn, has profound implications for social and economic development and environmental quality.

Policy lessons and priorities

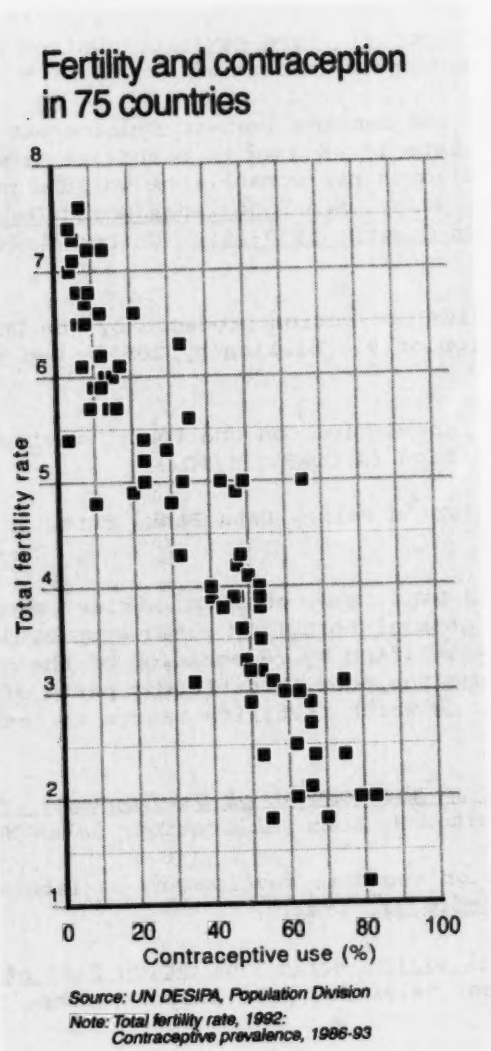
38. There is increasing evidence that successful policy interventions to influence long-term demographic trends involve simultaneous action targeting a range of determinants: income distribution, improvement in the status of women, basic education, information and communication, primary health care (including family planning) and employment opportunities.[10] A recent study of the links between the educational level of girls and fertility rates in 14 African countries showed that primary education reduced fertility in half the countries, and that secondary education did so in every case. The greatest success in reducing fertility was evident in the countries with the highest levels of female schooling, the lowest child mortality rates and the most vigorous family planning programmes.[11]

39. In the short term, providing contraceptives to close the "fertility gap" between the number of children born and the number of children desired remains a powerful and logical policy priority. The World Fertility Survey indicates that total fertility rates and contraceptive use are closely correlated; in many countries with high fertility rates, contraceptive use remains below 20 per cent (see figure II.8).

40. While recent downward trends in population growth and fertility rates are very encouraging, they will require additional policy efforts if they are to be sustained. As more women enter their reproductive years (a consequence of "demographic potential"), the need for family planning services will increase rapidly. During the 1990s, approximately 100 million more couples will need family planning services just to maintain current rates of contraceptive use. In order to realize the declining fertility rates projected in the United Nations medium population variant, about 75 million more couples will need access to family planning by the year 2000.

41. Regional differences in fertility rates, and the provision of family planning, should be a particular cause for concern, given that the highest population growth rates are, generally, occurring in the poorest and environmentally most fragile parts of the world.

Figure II.8


Fertility and contraception in 75 countries
Total fertility rate
8
7
6
5
4
3
2
1
0
20
40
60
80
100
Contraceptive use (%)
Source: UN DESIPA, Population Division
Note: Total fertility rate, 1992:
Contraceptive prevalence, 1986-93

Notes and references

[1] World Resources Institute, World Resources Report, 1996-97 (New York and Oxford, Oxford University Press, 1996).

[2] World Population Prospects: 1996 Revision (United Nations publication, forthcoming), annex I, Demographic indicators.

[3] According to the United Nations instant replacement fertility projection, where the total fertility rate is assumed to stabilize immediately at replacement level (2.06 children per woman), the world's population would still increase to 7.1 billion by 2025. See Long-range World Population Projections: Two Centuries of Population Growth, 1950-2150 (United Nations publication, Sales No. E.92.XIII.3).

[4] The most recent medium projection produced by the United Nations estimates a lower population of 9.4 billion by 2050. See World Population Prospects ....

[5] Report of the Secretary-General on the fourth review and appraisal of the World Population Plan of Action (A/CONF.171/PC/3).

[6] United Nations Population Policy Data Bank, cited in World Resources Report, 1996-97 ....

[7] According to a World Bank study of 64 countries, when the income of the poor rises by 1 per cent, general fertility rates drop by 3 per cent. However, this conclusion should be qualified by recognition of the great social and cultural heterogeneity among the poor in different parts of the world, which is highly relevant to the way in which fertility reacts to improving living conditions.

[8] Fertility Behaviour in the Context of Development: Evidence from the World Fertility Survey (United Nations publication, Sales No. E.86.XIII.5).

[9] H. Oshima, "Impacts of economic development on labor markets, education and population in Asia", Ambio 21, 1992.

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III. ENERGY AND MATERIALS CONSUMPTION

Introduction

42. Energy and raw materials are fundamental to economic activity and human well-being. As the size of the world economy has grown (approximately fivefold since the Second World War), so resource consumption has accelerated at a rate unprecedented in human history. During the 1960s, energy and steel use in the industrialized countries increased at rates that would have doubled total consumption by 1987 and quadrupled it by 2000. This pace and scale of growth gave rise to fears that such exploitation rates of non-renewable resources could not be sustained. During the 1970s, predictions abounded that the world would shortly "run out" of fossil fuels and other essential raw materials.

43. Since then, however, rising demand has generally been matched by discoveries of new reserves and substitution between resources, in response to the operation of market forces and technological advance. Concerns have shifted away from resource depletion to a wider and more complicated package of issues relating to the provision of adequate energy supplies in developing countries and the environmental and health impacts resulting from conventional patterns of energy and materials use.

44. The Brundtland Report of 1987 pointed to the tensions between increased levels of energy and material use required for economic growth in developing countries and the environmental (and hence financial and social) costs that could be expected from business-as-usual growth in the developed and developing world. It called for a major reorientation of policies towards efficient technologies and conservation efforts but anticipated that even this solution would not prevent increased levels of global and regional environmental degradation. The challenge today remains the same: to meet an enormous projected global demand for resources, especially energy, through the use of new products, technologies and consumption patterns which will provide rising standards of living for all while minimizing economic costs and risks to human health and the environment.

Transitions in resource use

45. Economic growth and social modernization in the industrialized countries has been characterized by major changes in resource use. Energy and material consumption rose rapidly during the nineteenth and first half of the twentieth centuries to meet demands from intensified agriculture, construction and industrialization. This phase was followed by a decrease in the growth rate of resource use as economies matured and became more efficient. Over the same period, primary energy sources shifted from traditional renewables (wood, other biomass) to fossil fuels, with an increasing dependence on electricity as the end uses of energy diversified. Materials use is still changing, from an emphasis on heavy, bulk commodities to lighter, higher-value metals and composites. Some higher-income developing countries are now undergoing elements of this transition, but significant differences between the industrialized and developing countries are evident in both levels and patterns of resource consumption.

Trends in resource consumption ...

46. World commercial energy use accelerated sharply after 1950, growing at an average annual rate of 5 per cent till 1970, when the growth rate slowed. By 1993, world energy consumption was almost 50 per cent greater than in 1973.[1] The industrialized countries still account for over 60 per cent of total consumption, though their share is declining as the rest of the world develops. Developing countries experienced exceptionally fast growth rates during the 1960s and 1970s as a result of economic development and the rapid replacement of traditional by commercial (fossil) energy sources. However, this growth took place from a very low consumption base in absolute terms. This fact, together with high population growth, means that per capita consumption in developing countries remains very low by the standards of industrialized countries (see chap. VI, table).

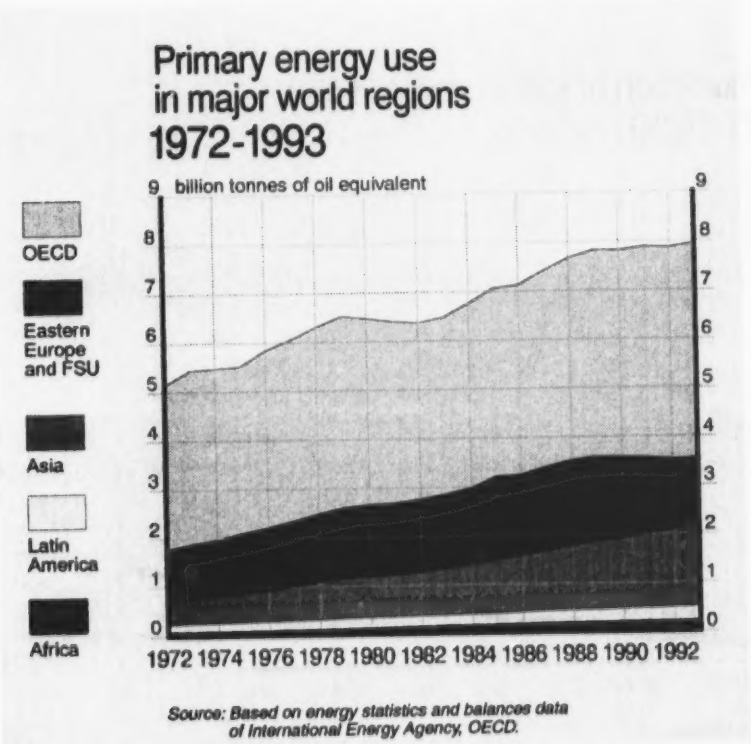
47. World demand for metals and minerals rose by 120 per cent between 1961 and 1990. Growth rates were highest among low- and middle-income countries, where infrastructure and industries are rapidly being established. Demand in the mature economies of the Organisation for Economic Cooperation and Development (OECD) has slowed considerably since the 1970s; global demand growth rates have slowed from about 6 per cent in the 1960s to under 2 per cent in the 1990s, though this represents a considerable increase in absolute terms (figure III.2).

48. Despite rising levels of energy and material consumption, there is no short-term prospect of scarcity. Estimates of world energy reserves have increased significantly over the past 20 years and energy prices in recent years have remained low, indicating no perceived or anticipated scarcities in the near future. Proven reserves of the most important metals and minerals have also risen since 1970. Consumption as a proportion of reserves has declined and long-term prices for most raw materials have trended steadily downward.[2] Concerns in recent years have turned from exhaustion of non-renewable resources to the degradation of renewable resources - soil, water, forests - and risks to human health which follow from current resource use patterns.

... and their social and environmental impacts

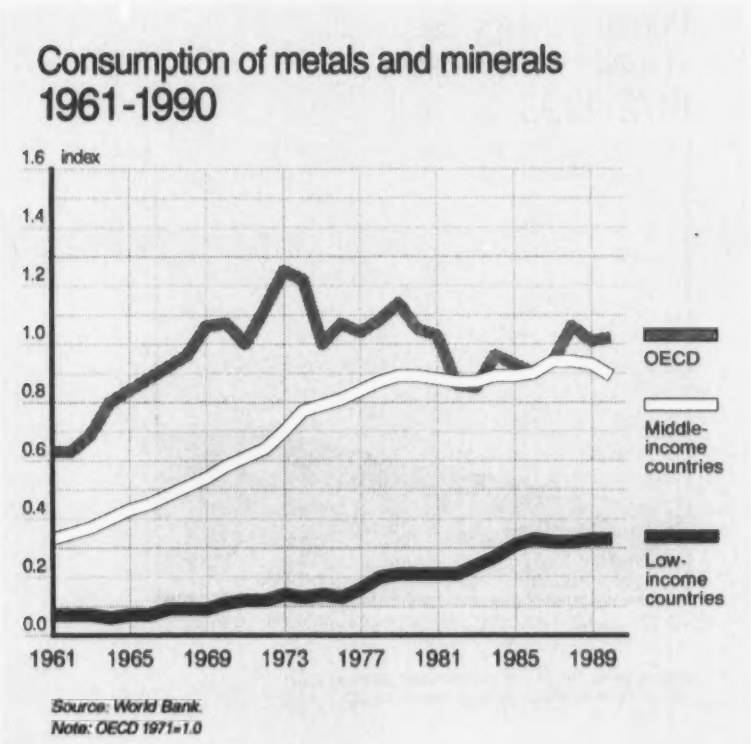
49. Despite the massive investments in energy supply over the past 30 years, over 2 billion people, mostly in rural areas of developing countries, still have little access to commercial energy supplies. Poverty, remote location, or both, leave communities dependent on animal or human energy for labour and fuelwood or animal dung for cooking and heating.[3] Wood still provides up to 50 per cent of national energy needs in a number of Asian and sub-Saharan countries.[4]

Figure III.1



Source: Based on energy statistics and balances data of International Energy Agency, OECD.

Figure III.2


Consumption of metals and minerals
1961-1990
1.6 index
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1961
1965
1969
1973
1977
1981
1985
1989
OECD
Middle-income countries
Low-income countries
Source: World Bank.
Note: OECD 1971=1.0

50. Lack of access to commercial energy is a severe constraint on social and economic development. The lowest-income countries are also those with lowest per capita energy consumption; social indicators such as literacy rate, infant mortality, life expectancy and total fertility rate all improve sharply with increased per capita income and energy consumption.[5] In addition, the use of traditional fuels is now understood to be damaging to human health; many studies document a correlation between indoor air pollution and the incidence of respiratory ailments and congestive heart failure.[6]

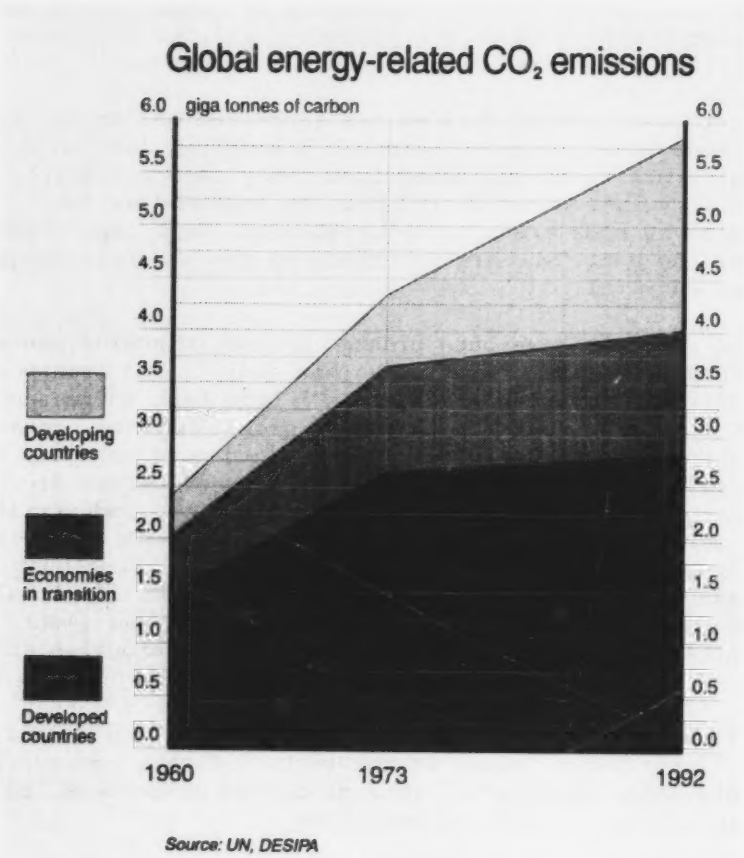
51. Population growth over recent decades has increased the demand for traditional fuels, especially in poor regions. Historical data on consumption of fuelwood are scarce but it is estimated that today some 1.8 billion m^3, more than half of the total volume of wood produced, is consumed as fuel.[7] Fuelwood consumption is leading in some areas to deforestation, soil impoverishment and further hardship for the poor, who are dependent on the natural resource base for their day-to-day survival.

52. Quite different problems have been created by the intensive use of fossil fuels in the developed countries. Poor urban air quality and transboundary air pollution from acidifying compounds ("acid rain") have been addressed with some success in the past 30 years. But the threat of global warming, caused by rising concentrations of greenhouse gases, has emerged more recently and has yet to be tackled effectively. Atmospheric concentrations of carbon dioxide (CO_2), a leading greenhouse gas, have increased steadily since the industrial age began (figure III.3). Evidence is strong that most of the increase is attributable to human activity, in particular, to fossil fuel combustion.[8] Continuation of these emission trends poses serious, though uncertain, risks of global and regional climate change, leading to unpredictable rises in sea level, inundation of low-lying coastal areas, migration of ecosystems and disruption of agriculture.

53. The industrialized countries today account for about 70 per cent of carbon dioxide emissions; historically, about 84 per cent of fossil energy carbon dioxide emitted since 1800, which still remains in the atmosphere, is the result of past emissions in the industrialized countries.[1]

54. Atmospheric pollution from fossil fuel combustion has also grown rapidly in developing countries, however. Current per capita primary energy use in some of the higher-income economies of Asia already exceeds that of some poorer OECD countries. Industrial and transport-related emissions are seriously undermining human health in many developing country cities; evidence is also accumulating that acid precipitation is reducing yields of some agricultural crops. Transport is now the fastest growing end-use of energy in developing countries; the sector grew at an average annual rate of nearly 6 per cent between 1970 and 1990, compared with just over 2 per cent in the developed countries.[1]

Figure III.3



Source: UN, DESIPA

The role of technology

55. Technologies enable humans to expand their range of activities and transform the Earth's resources. Technological advances, in principle, enable more productive use of resources, thereby delivering equivalent or improved services while greatly reducing health and environmental burdens. Two long-term trends offer particular hope for mitigation of these adverse impacts: improvements in energy and material efficiency and decarbonization of energy sources.

Energy and materials intensity

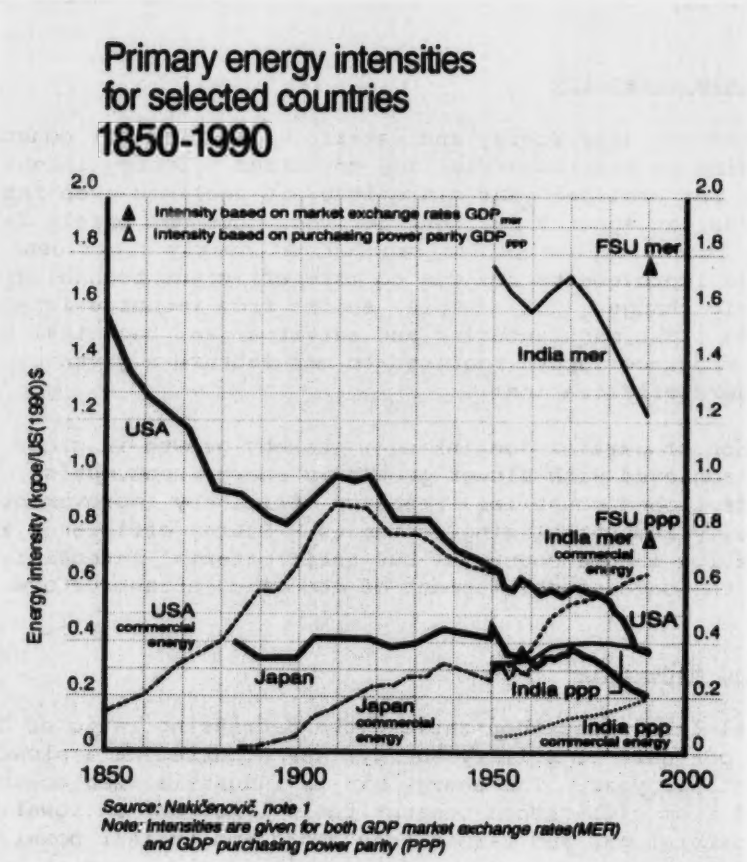
56. Resource intensity (the energy and materials required for constant economic output) is declining in the industrialized countries. Energy intensity has fallen by about 1 per cent per year since 1800; it declined even faster during the 1970s and 1980s, at about 2 per cent per year, but has barely fallen since 1990.[9] Materials intensity has fallen rapidly, at nearly 2 per cent per year since 1971. These improvements are due to more efficient technologies, structural economic changes (for example, shifts from resource-intensive industries towards light manufacturing and services) and technical advances which reduce the resource inputs required to manufacture a given product (energy efficiency and "dematerialization").

57. The phenomenon of partial "delinking", whereby growth in gross domestic product (GDP) is achieved with slower growth in energy consumption, is most advanced in the developed countries; resource efficiency improvements are also evident in the newly industrializing economies. Energy efficiency is now improving in some low-income countries but their material intensities are still high, reflecting the ongoing development of economic infrastructure (figure III.4).

Cleaner energy and materials

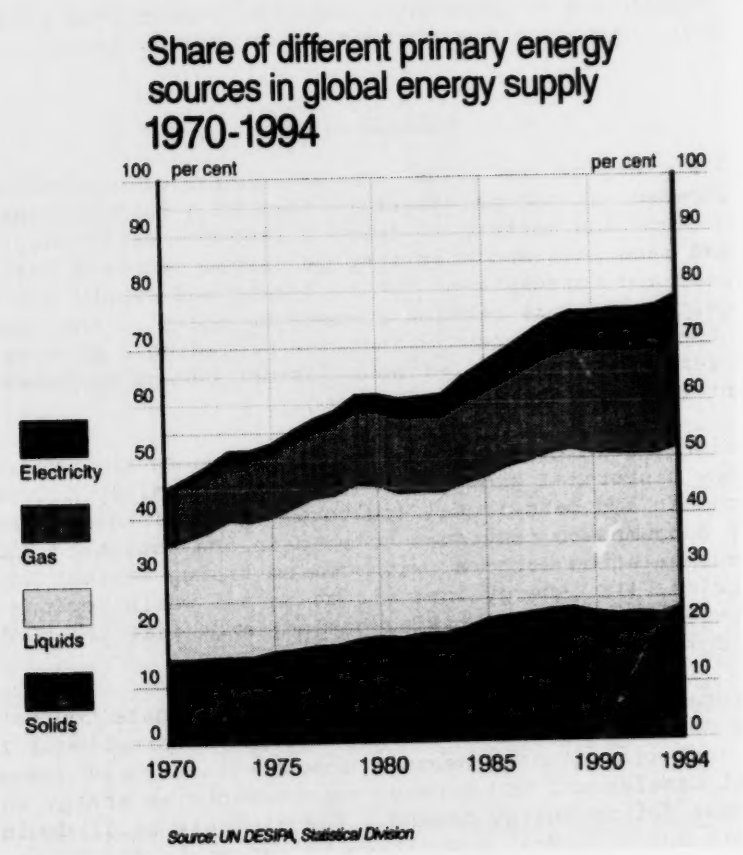
58. At the global level, decarbonization (the decreasing ratio of average carbon emissions per unit of primary energy) has occurred at a slow rate of about 0.3 per cent per year. The energy mix in industrialized countries has gradually shifted from high-carbon content fuels like coal to lower-carbon fuels such as oil and natural gas and carbon-free hydro and nuclear power (figure III.5). The carbon intensity of the major coal-dependent Asian economies is currently high - comparable to the industrialized countries in the nineteenth century - but the evidence so far indicates that once the trend to decarbonization begins countries advance at roughly comparable rates.

Figure III.4



Source: Nakićenović, note 1
Note: Intensities are given for both GDP market exchange rates(MER) and GDP purchasing power parity (PPP)

Figure III.5


Share of different primary energy sources in global energy supply
1970-1994
100 per cent
per cent 100
90
80
70
60
50
40
30
20
10
0
Electricity
Gas
Liquids
Solids
1970
1975
1980
1985
1990
1994
Source: UN DESIPA, Statistical Division

59. Information on material flows is weak for most countries but it appears that economic development is characterized by a decline in the intensity of use of heavy commodities - lumber, concrete, lead - and a shift towards "value added", sophisticated materials such as aluminium, plastics and composites. The number of materials in circulation has multiplied dramatically with technological progress and rising consumer demand for new products and services; for example, an estimated 90,000 chemicals are now in commercial use. It is the volume and heterogeneity of materials consumed, and the uncertainty surrounding their potential health and environmental impacts (rather than rates of use and possible depletion), that have now emerged as key policy issues.

Looking ahead

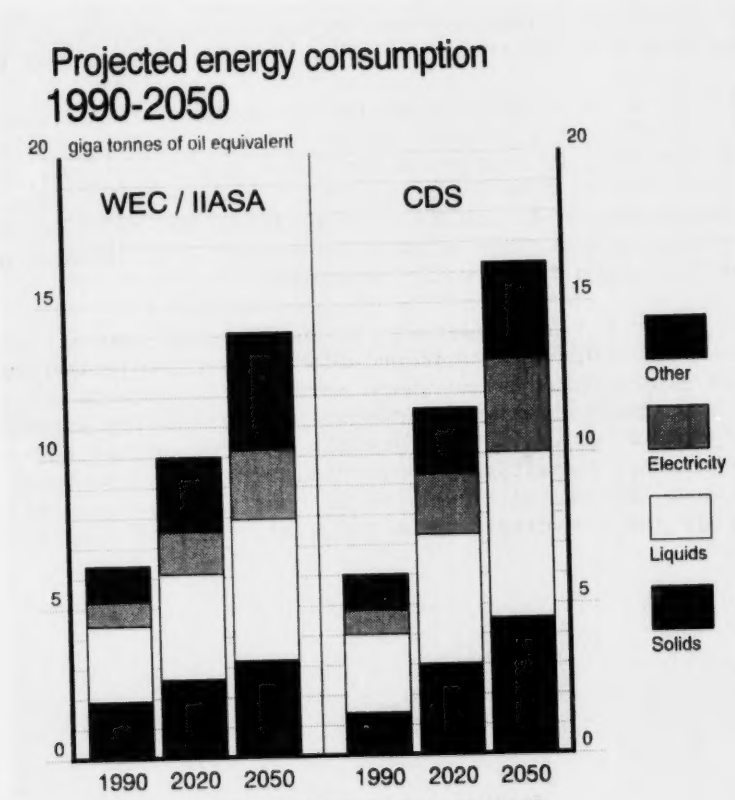
60. A principal anxiety of the 1970s, the exhaustion of non-renewable resources, has receded, if not permanently, then to a more distant future. The capacity of technology and markets to improve resource efficiency, substitute energy sources and materials and side-step perceived problems has been a recurring surprise, and forecasts of future demand and supply now allow for a wider range of outcomes. This section focuses on energy: the "energy challenge" over the next half century involves providing a growing world population with sufficient energy, without further damage to human health or disruption of critical environmental functions.

61. The Conventional Development Scenario (CDS) assumes that energy demand and supply will follow historical growth paths, which are mainly driven by demographic, economic and behavioural (cultural) determinants. The scenario assumes that (i) consumption continues to rise in the household and commercial, industry and transportation sectors, with demand rising fastest in the developing countries; (ii) energy intensities in all world regions decline, though not sufficiently to offset rising demand; and (iii) the global energy mix continues to be dominated by fossil fuels.

62. The CDS forecast may be unduly pessimistic. A "Middle Course" scenario developed by the World Energy Council (WEC) and the International Institute for Applied Systems Analysis (IIASA)[10] assumes modest estimates of economic growth and technological development and greater improvements in energy intensity, which lead to lower future energy demand. Fossil fuels still dominate the primary energy mix but a gradual transition to renewable energy is seen as feasible after 2020 (figure III.6).

63. The Middle Course scenario could still could be improved upon. The "Low CO_2-Emitting Energy Supply System" (LESS) scenario, developed for the Intergovernmental Panel on Climate Change (IPCC)[11] assumes significant improvements in energy efficiency which cause primary energy consumption to rise much more slowly than GDP. The scenario also posits shifts in the fuel mix in favour of renewable energy sources, primarily modern biomass.

Figure III.6



Source: Based on WEC/IIASA1995 Report: Raskin and Margolis. Stockholm Environment Institute.
Note: Other includes alcohol, gas, heat and hydrogen.

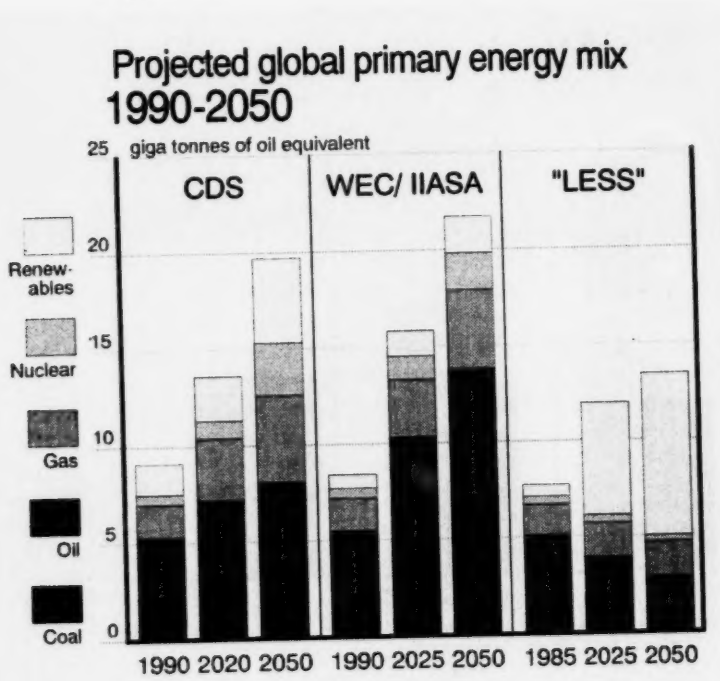
64. The composition of the global energy mix assumed in the CDS, Middle Course and LESS scenarios are shown in figure III.7, and the levels of CO_2 emissions that would result from each of them are shown in figure III.8.

65. More pessimistic scenarios are also possible. Most conventional projections assume that developing countries will follow an energy development path similar to that experienced in developed countries. In developing countries, however, the energy transition from traditional to modern fuels may slow down or even stagnate if coal reserves continue to prove more economically attractive (in industrializing regions) or socio-economic development is insufficient to generate the income necessary to buy commercial fuel supplies.

66. Such a situation (a stagnating energy transition and continued poverty) would imply that traditional biomass fuels continue to play an important role in many developing regions, in particular in rural and low-income urban areas. Due to increasing population, over-exploitation of scarce traditional fuels, especially fuelwood and dung, would increase local and regional environmental stress and adversely affect food production (chap. IV). Health problems from indoor combustion of such fuels would continue.

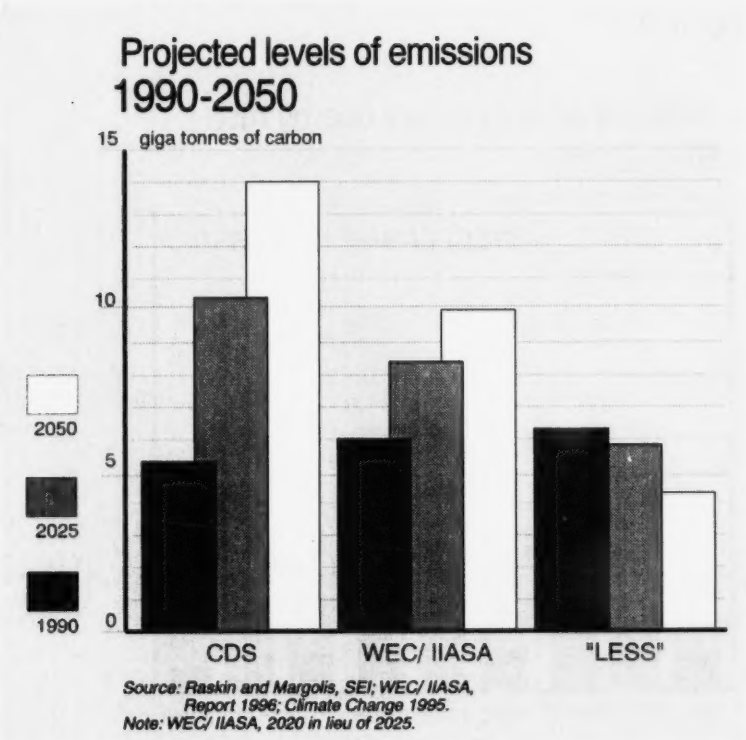
67. Energy and materials are essential to development and all scenarios agree that consumption will increase substantially to meet projected demand, especially in developing countries where per capita consumption is currently too low to support even basic living standards. The scenarios suggest that meeting future demand could be achieved with greatly reduced social and environmental harm if the historical transitions from traditional to commercial fuels, towards improved efficiency (declining intensity of use) and towards safer sources (low-carbon energy and non-hazardous materials) could be greatly accelerated.

Figure III.7



Source: Based on WEC/ IIASA, Report 1995; Raskin and Margolis, Stockholm Environment Institute; Williams, note 13.

Figure III.8



Source: Raskin and Margolis, SEI; WEC/ IIASA, Report 1996; Climate Change 1995.
Note: WEC/ IIASA, 2020 in lieu of 2025.

The role of policy

68. Major efforts have been made to improve access to commercial energy. Public expenditures on power sector infrastructure in developing countries rose from about 0.6 per cent of GDP in the 1960s to over 1.7 per cent in the 1980s. However, a key constraint to future energy development in developing countries is lack of capital. The World Energy Council has estimated that energy investment requirements in developing countries between 1990 and 2020 will be US$ 3 to US$ 7 trillion (in 1990 dollars) if the conventional energy transition is pursued.[12] The costs of extending electricity grids to meet the needs of the rural poor in developing countries are beyond all foreseeable domestic budgets and development aid.

69. In order to improve competitiveness and reduce dependence on energy imports, many industrialized countries have deregulated domestic energy markets and introduced incentives for energy saving. Since the late 1980s, fossil fuel prices in OECD countries - except the United States - have been higher than market clearing levels. Efficiency standards established for cars, buildings and a range of consumer appliances in developed and developing countries have also produced measurable energy savings. By contrast, social and political considerations have led to energy being heavily subsidized in developing countries and, until the 1990s, in the countries of Eastern Europe and the former Soviet Union. In 1992, government subsidies worldwide for conventional energy amounted to over US$ 200 billion, more than official development assistance from all sources (taking debt repayment into account).[3] Artificially low energy prices and restrictions on market-based competition in energy markets have encouraged inefficiency and wasteful use patterns and have discouraged energy conservation measures.

70. Policy measures aimed at encouraging materials efficiency have been stimulated in developed countries by the sheer volume of materials used and the economic, environmental and political problems associated with disposal. A new agenda of "eco-efficiency" is developing, focused on delivering equivalent or higher standards of goods and services with greatly reduced material throughput. Measures include material and product taxes, recycling targets, mandatory producer take-back requirements and consumer information schemes. However, it remains too early for significant changes to be observed at the national level.

71. The trend towards lower-carbon fuels has, on balance, been favoured by market forces, though the rapid penetration of the energy market by (carbon-free) nuclear power has been due almost entirely to government support. The transition is less clear in some developing countries where, for example, rapidly rising demand for electricity and transportation has encouraged high consumption of oil alongside continued use of traditional renewables. Renewable energy sources, such as wind and solar power and hydrogen fuel cells, remain under-exploited in both developed and developing countries. Uncompetitive costs, relative inefficiency and the problem of variable supply remain barriers to their more widespread use. This, in part, reflects prevailing R&D spending priorities. The developed countries currently spend over 50 per cent of their annual US$ 8 billion energy research budgets on (civil and military) nuclear programmes; less than 10 per cent is spent on renewables.[13]

Policy lessons and priorities

72. Market liberalization and privatization in the energy sectors of developing countries may be enough to meet the needs of enterprises but they have done little to improve energy services in poor rural areas. The most urgent situations are in low-income developing countries which are dependent on imports for their commercial energy supplies and where shortages of fuelwood are becoming acute. Ensuring adequate, affordable and secure energy supplies which sustain development in the short term will require accelerated development of indigenous energy resources, for example through tree planting. In the longer term, increased capacity for producing commercial primary energy - both fossil and renewable - is essential.

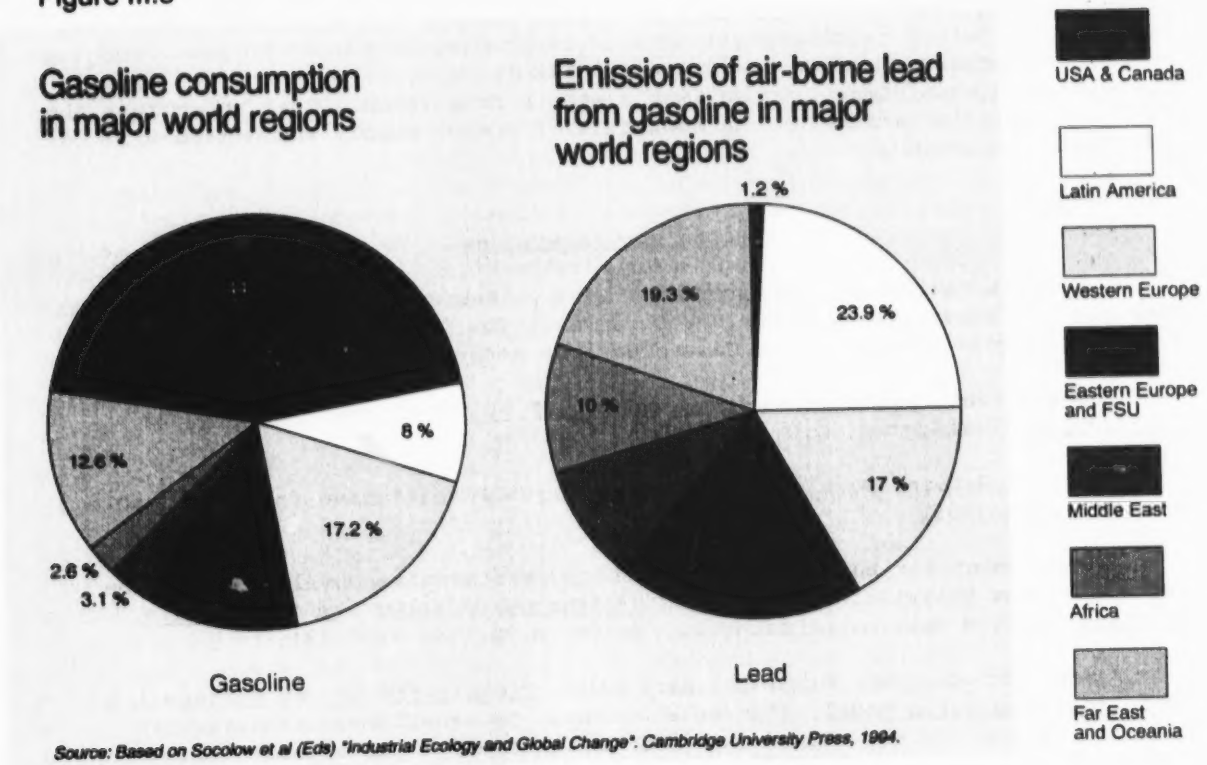
73. Energy efficiency will be encouraged, over the long term, in signatory countries to the United Nations Framework Convention on Climate Change, which requires reductions in national emissions of carbon dioxide. However, energy-related CO_2 emissions in OECD countries rose by about 4 per cent between 1990 and 1995, and very few countries are currently on target to meet their reduction goals.[14] The most potent policy instrument - "environmental" energy taxes - remains politically difficult to implement. However, some developed countries are exploring the idea of "ecological tax reform" in which increased taxation on fossil fuels (or pollution) is offset by reduced taxes on, for example, labour. This approach is reportedly meeting with a more favourable reception from energy users.

74. In developing countries, it is clear that, whatever the promise of energy-efficient technologies and advanced materials science, significant increases in commercial energy consumption will be essential for real economic growth and social development. Nevertheless, improved efficiency is receiving increased attention from many policy makers and energy providers under pressure from budgetary constraints. The marginal costs of meeting at least some of the existing and projected demand through efficiency savings and demand management approaches are estimated to be far lower than providing additional capacity by extending electricity grids. However, this approach is likely to make little headway as long as artificial incentives for energy use persist.

75. The switch to cleaner fuels in the industrialized countries has been encouraged by international agreements on air quality such as the Vienna Treaty protocols setting reduction targets for SO_x and NO_x. There is a clear need for similar regional agreements between industrializing countries, which are now beginning to suffer the full effects of transboundary pollution.

76. Policy measures targeting specific hazardous emissions or substances have proved highly effective, where evidence of damage to human health or the environment is strong and substitutes exist. For example, reductions in lead emissions in North America were due almost entirely to the legislated phase-out of leaded gasoline (figure III.9).

Figure III.9



Source: Based on Socolow et al (Eds) "Industrial Ecology and Global Change". Cambridge University Press, 1994.

77. In conclusion, structural changes in the global energy system are relatively slow, reflecting the long lifetime of facilities and infrastructure. On average, major transitions (for example, the replacement of coal by crude oil) take about 50 years. The total capital stock of the energy sector can be expected to be replaced at least twice by the end of the next century, offering numerous opportunities for efficiency improvements and shifts away from carbon-intensive fuels. Changes in materials use may be much faster, offering even greater opportunities for policy intervention. Major historical transitions in resource use to date have been largely the result not of policy intervention but of technological advance responding to market forces. Judging by recent experience, price rises are not likely to occur soon enough, or with the necessary consistency, to deliver a smooth transition. This underlines the fact that policies affecting the evolution of energy supply and demand will be of crucial importance.

Notes and references

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[6] See, for example, B. H. Chen and others, "Indoor air pollution in developing countries", World Health Statistics Quarterly, 1990, vol. 43, No. 3.

[7] European Forest Institute and Norwegian Forest Research Institute, "Long-term trends and prospects in world supply and demand for wood and implications for sustainable forest management", report prepared for the Ad Hoc Intergovernmental Panel on Forests of the United Nations Commission on Sustainable Development, July 1996.

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[11] R. H. Williams, "Variants of a Low CO_2-Emitting Energy Supply System (LESS) for the world", report prepared for the IPCC Second Assessment Report, Working Group IIa, Energy Supply Mitigation Options, 1995.

[12] A more recent (1995) study by the International Institute for Applied Systems Analysis and the World Energy Council revises these requirements upwards to between US$ 6 and US$ 9 trillion by 2020 and between US$ 11 and US$ 18 trillion by 2050.

[13] International Energy Agency, Annual Report, 1995.

[14] World Energy Council, Climate Change Negotiations: COP-2 and Beyond, Report No. 6, September 1996.

IV. AGRICULTURE AND FOOD SUPPLY

Introduction

78. The Malthusian spectre of mass starvation was revived in the late 1960s and early 1970s when rapid population growth was seen by many environmentalists as a primary cause of the mass famines experienced in Asia and Africa. The 1974 World Food Conference was held at the height of a perceived world food crisis, the result of poor harvests in the world's major food producing regions and soaring food commodity prices, aggravated by the 1973 oil shock. The Conference established the goal that hunger, food insecurity and malnutrition should be eradicated within a decade. Raising food production became an international policy priority for the remainder of the decade and investment in agricultural research and development increased significantly.

79. Over the next decade, world food production grew rapidly and a decline in the incidence of mass famines generated optimism over the ability of farmers to feed ever-growing numbers of people. Rising global harvests, food surpluses in industrialized countries and steadily falling prices for most food commodities encouraged a perception among many donor Governments that food supplies were secure for the foreseeable future, despite the fact that many millions of people continued to go hungry. During the 1980s, the intensity of efforts to boost production declined and concerns shifted to the environmental and social consequences of intensified farming methods, especially land degradation, water pollution, rural unemployment and health impacts associated with pesticide use.

80. More recently, a number of factors have combined to revive doubts about food security in the longer term. The growth rate in world harvests has slowed markedly, many marine fish stocks have become depleted, population growth continues to be most rapid in those areas which are already food insecure - and land degradation is now measurably undermining the agricultural resource base. In late 1996, the World Food Summit was convened to examine these developments and called for a halving of the numbers of hungry people by 2015. Policy approaches recommended at the Summit demonstrate a new understanding that food security must be addressed within the wider context of poverty eradication, economic development and environmental sustainability, as well as improved agricultural technology.[1]

The agricultural transition

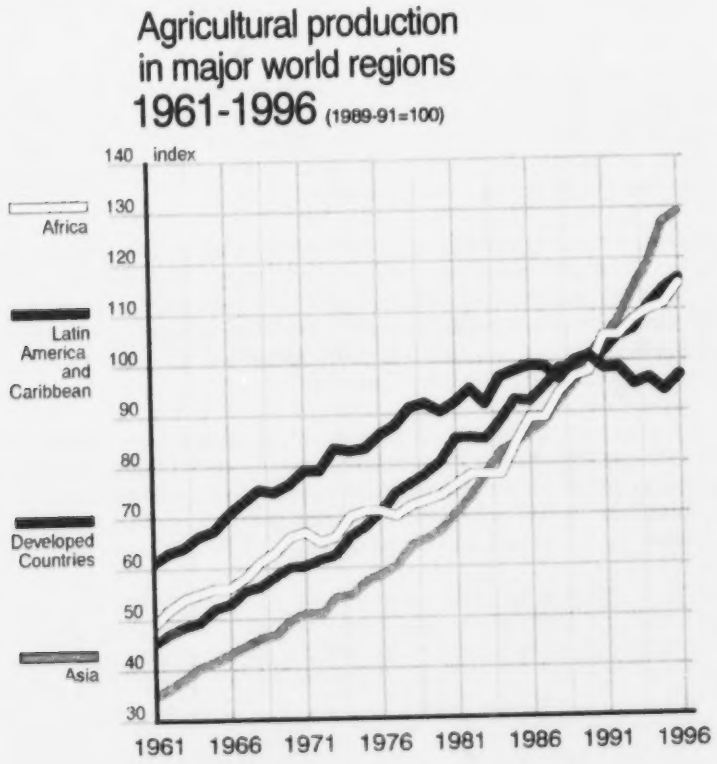
81. The past two centuries have witnessed a worldwide, but still incomplete, shift from low-input, low-output agriculture to more intensive farming systems. In extensive agricultural systems, production tends to be raised by cultivating additional land as necessary. The "take off" phase leads to raised productivity (yields per hectare), achieved through the use of new crop varieties, improved cultivation techniques and increased inputs of agrochemicals and fossil fuel energy. The mature phase of the transition is characterized by slower yield growth rates; productivity may even decline locally, if the adoption of more intensive techniques has resulted in damage to soil and water resources.

Food supply

82. World agricultural production has risen impressively over the past 40 years (figure IV.1). Since 1961, the industrialized countries have raised cereal production by an average of 1.7 per cent each year. The annual rate of increase in developing countries averaged 3 per cent and they now account for well over half the world cereal harvest.[2]

83. The Green Revolution of the 1950s and 1960s enabled some developing countries, notably India and China, to increase their food production dramatically through the use of irrigation, fertilizer and scientifically bred new strains of rice and wheat. Other developing regions, including North Africa, much of South America and South Asia, achieved major though less spectacular increases. Sub-Saharan Africa so far has continued to raise food production more through the cultivation of new land than through intensified production. Fertilizer application rates and average yields in much of the region remain well below levels elsewhere.

Figure IV.1



Source: FAO, FAOSTAT
Note: Developed countries include Former Soviet Union

84. Marine and inland fisheries are also a vital part of the world's food supply. Approximately 950 million people, mostly in developing countries, rely on fish for their primary source of protein. The marine catch (representing about 78 per cent of the total) rose nearly fivefold between 1950 and 1989; it has dropped slightly since then but the total catch has continued to rise thanks to expanded aquaculture production. This steady increase masks a more complicated picture in which new species of fish, and new fishing grounds, have been successively exploited and depleted. A recent study indicates that an increasing proportion of the world's major ocean fisheries are now at, or nearing, the point of over-exploitation (figure IV.2).[3] The greatest potential for raising future fish harvests appears to lie in conservation of depleted stocks, improved management of rich fishing grounds such as the Indian Ocean, and in continued expansion of aquaculture which already contributes nearly one quarter of the total fish supply in Asia.[4]

85. The overall growth in world food supply conceals a number of trends which, if not corrected, will have disturbing implications for future food security.

86. Agricultural intensification in recent decades has taken a heavy toll on the environment. Poor cultivation and irrigation techniques and excessive use of pesticides and herbicides have led to widespread soil degradation and water contamination. Approximately 300 million hectares worldwide are now severely degraded and local farming systems abandoned; a further 1.2 billion hectares - 10 per cent of the earth's vegetated surface - are at least moderately degraded.[5]

87. Competition for land is increasing. Development and population growth claim land for housing, industry and infrastructure. Worldwide data are not available, but economic growth in Asia is estimated to have reduced cropland area in some countries by 1 per cent per year;[6] slower rates of land loss are still under way in the industrialized countries.

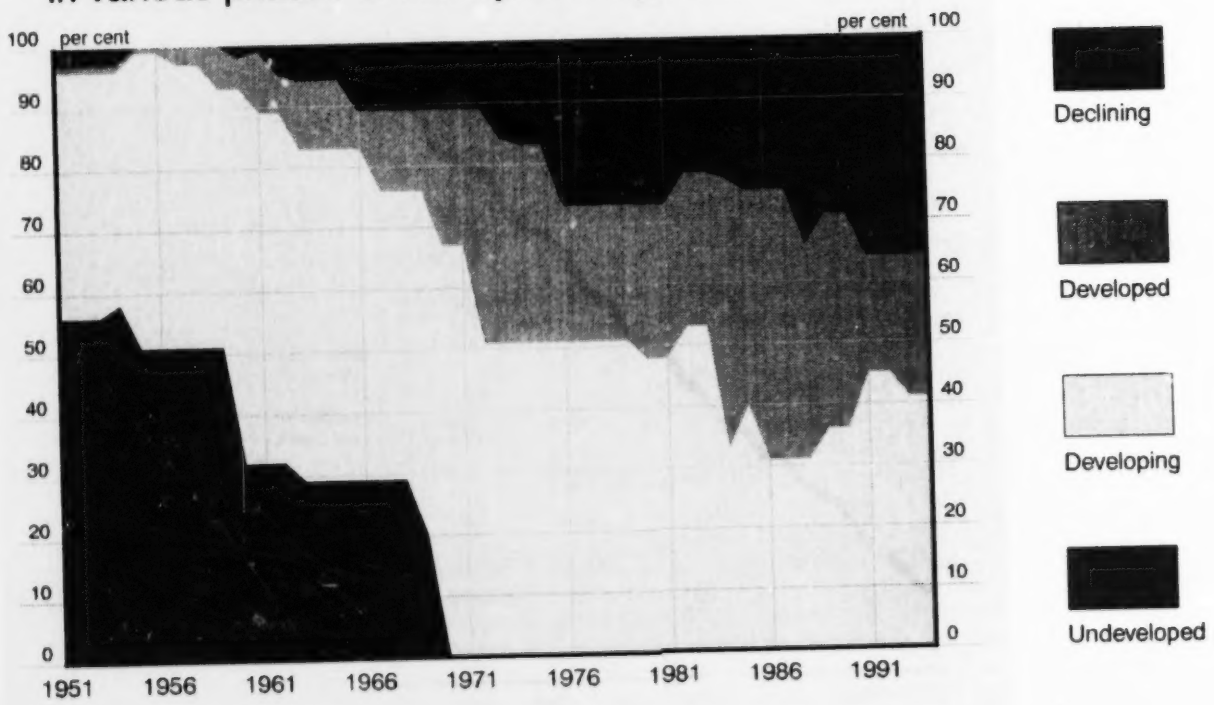
88. Dietary preferences are changing with increasing wealth in favour of meat and dairy products. Direct consumption of grain by humans is the most efficient use of available food supplies but more land in developing countries is now used for growing grain feed, fodder and forage for livestock in order to supply export feed to industrialized countries and to meet an increasing demand for meat and dairy products in developing countries.

89. Agriculture in parts of North America and Europe has reached a stage where public interest in "healthy food", recreational use of the countryside (made possible by mass ownership of private vehicles) and protection of wildlife and habitats are encouraging less intensive techniques. Policy incentives are being implemented to remove some cropland from production altogether.

90. The net effect of these trends (a static or declining productive land base and less efficient use of cereals) has been offset for many years by increasing yields. However, while yields and total world food production are still rising in absolute terms, the rates of growth have been declining since the early 1980s.[7] This situation, combined with rising population, means that per capita food production has grown relatively slowly (figure IV.3). Since 1984, the per capita grain harvest has actually declined by an average of more than 1 per cent per year (figure IV.3).

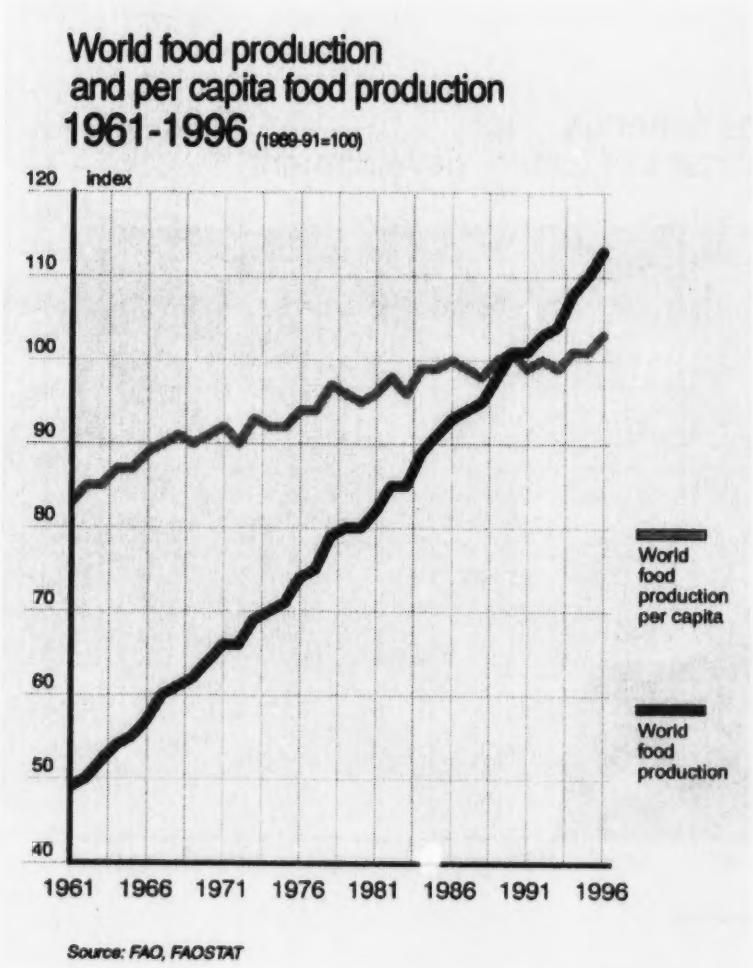
Figure IV.2

Major marine fisheries in various phases of fishery development



Source: FAO, Fisheries Department

Figure IV.3


World food production
and per capita food production
1961-1996 (1989-91=100)
120
index
110
100
90
80
70
60
50
40
1961
1966
1971
1976
1981
1986
1991
1996
World food production per capita
World food production
Source: FAO, FAOSTAT

Hunger amidst plenty

91. Globally, there is still abundant food. Between 1961 and 1994, per capita food supply in developing countries increased by 32 per cent and mass famines on the scale seen in the nineteenth and mid-twentieth century have not recurred. The proportion of the world's population who are hungry or chronically undernourished has fallen from 35 to 21 per cent. Rising food production has not delivered universal food security, however. Nearly 840 million people remain hungry worldwide and the number of chronically undernourished in sub-Saharan Africa has more than doubled since 1969 (figure IV.5).[8]

92. During the 1970s, food availability increased significantly in many countries in East and West Asia, Latin America and North Africa, despite rapidly growing populations. These gains were due not only to improved agricultural productivity but also to economic development (or in some cases borrowing), which enabled rapid growth in food imports. Net imports of cereals in developing countries more than tripled between 1969/71 and 1979/81.[9] But in South Asia, per capita food supplies stagnated and they declined in sub-Saharan Africa, where domestic production and imports could not match population growth.

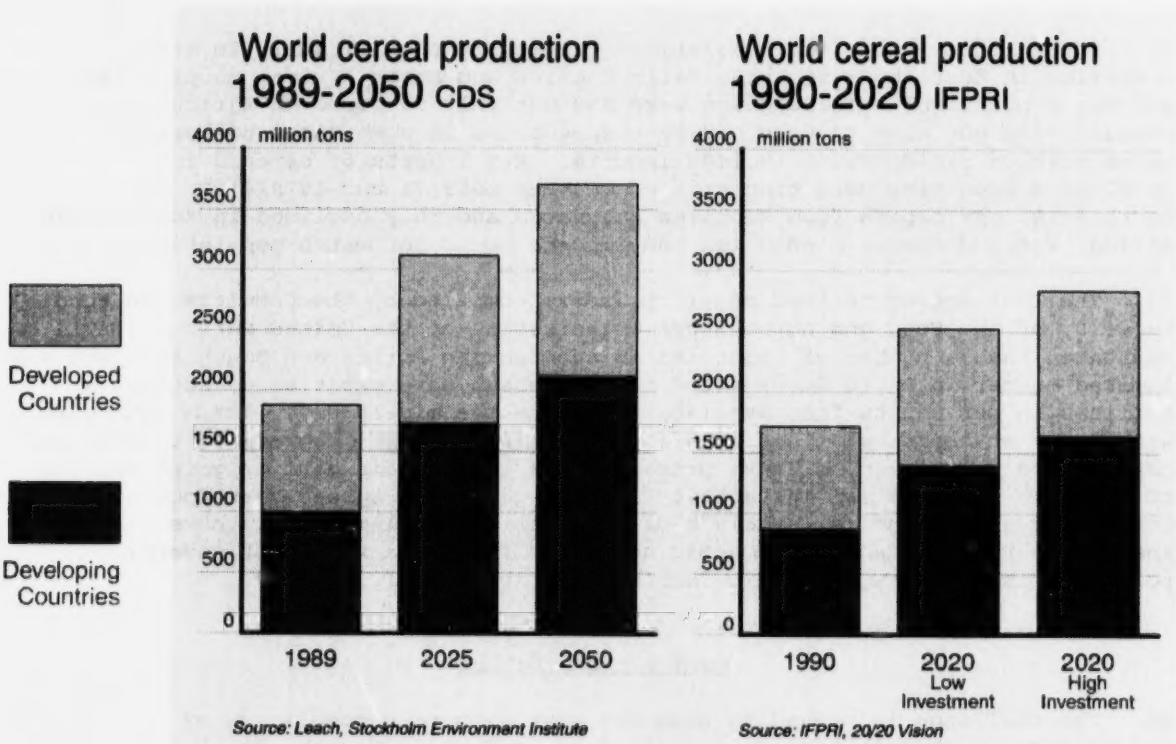
93. The 1995 aggregate food security index, compiled by the Committee on Food Security of the Food and Agriculture Organization of the United Nations (FAO), indicates that a number of countries in sub-Saharan Africa and South Asia and a limited number in Latin America and the Caribbean have experienced serious declines in per capita food availability since the mid-1980s.[10] These countries, with "low" or "critical" food security, have made little progress in raising per capita food production, or have proved unable to maintain earlier gains because of economic or political instability. It is generally agreed that food insecurity at present is largely a distributional problem; people have inadequate physical and/or economic access to food as a result of poverty, political instability, economic inefficiency and social inequity.

Food for the future

94. The challenge in providing adequate nutrition to a population of 9.4 billion in 2050 is threefold: (i) food production must be doubled; given current regional population growth trends, a nearly threefold increase in supply will be required to feed the developing world and a fivefold increase for Africa and the Middle East; (ii) regional self-sufficiency will not be possible everywhere and food imports must increase; since food supply traditionally responds to demand (which is a function of income) and not to human need, the focus must be on ensuring that people have income to purchase the food they need; (iii) increased production must be achieved without further damage to the productive base (soils and water) or to human health.

95. Projections of future global food production and food security depend on underlying assumptions regarding population growth, available cropland, yield gains and diet (lifestyles). Recent long-term forecasts involve a wide range of outcomes because even small changes in underlying assumptions can lead to huge differences in future agricultural supply and demand (figure IV.4).

Figure IV.4


World cereal production
1989-2050 CDS
4000
million tons
3500
3000
2500
2000
1500
1000
500
0
1989
2025
2050
Source: Leach, Stockholm Environment Institute
World cereal production
1990-2020 IFPRI
4000
million tons
3500
3000
2500
2000
1500
1000
500
0
1990
2020
Low
Investment
2020
High
Investment
Source: IFPRI, 20/20 Vision
Developed
Countries
Developing
Countries

96. The Conventional Development Scenario assumes a global growth in food production of about 1.5 per cent per year, falling to around 1 per cent, resulting in doubled production by 2050. The potential for cropland expansion appears greatest in Africa and Latin America, but limited in developing Asia; cropland areas could decrease in industrialized regions. Irrigated areas are likely to increase only modestly. The greatest productivity gains are likely to come in Africa, where yields are currently well below average; yield gains could also be strong in China and Latin America. In industrialized countries, yield increases are expected to continue, though at a lower rate.

97. The International Food Policy Research Institute (IFPRI) has developed a number of scenarios of future food production, including two variants based on differing assumptions regarding investment in agricultural research.[11] Further cutbacks in public investment are expected to reduce production by about 10 per cent in developing countries (relative to a baseline scenario). Higher investment, by contrast, is projected to raise production and to create additional benefits in non-agricultural income growth, to increase public expenditures on social services and to improve access to water, sanitation services and education.

98. FAO has produced a forecast for 2010 which also assumes rapid technological improvement and projects a growth rate of 1.8 per cent per year.[12]

Food production and the natural resource base

99. Limiting factors in expanding cultivated land area include the scarcity of high quality agricultural land, the risk of environmental degradation of marginal cultivated lands and competition from alternative land uses, particularly urban growth and development in developing countries and "counter-urbanization" (urban-rural migration), tourism and leisure uses in developed countries. Competition for land between agriculture and forest cover will sharpen; recent estimates suggest that nearly two thirds of tropical deforestation - some 12 million hectares per year - is due to farmers clearing land for agriculture.[13] Scenarios developed by the Finnish Forest Research Institute suggest that tropical forest cover could decline from 1,757 million hectares (1990) to between 1,164 million hectares and 1,360 million hectares in 2025.[14]

100. While significant areas of Africa and Latin America remain to be opened up for agriculture, the costs to indigenous forest dwellers, forest and savannah vegetation and biological diversity are likely to be high. Additionally, the degradation and deforestation of watershed forests have an important impact on water quality, quantity and periodicity of flow (see chap. V, section on water and ecosystem functions). These facts suggest the need for a twin focus on increasing food production in more fertile areas (intensification) thereby reducing the need for further expansion into marginal and easily degraded non-agricultural lands, and developing technologies appropriate to less fertile areas which can improve farmers' opportunities to increase food production while minimizing the risk of environmental damage.

101. Water is likely to prove the most important constraint on raising food production (chap. V). Irrigated cropland area grew by 2-4 per cent annually

during the 1960s and 1970s but expansion has since slowed to less than 1 per cent per year.[15] This trend is not expected to be reversed in the short term, given low projected world food prices and the increasing economic costs and environmental and social impacts associated with major new irrigation schemes. Yields from existing irrigated land, especially in parts of China, India, Pakistan and the United States, are also expected to decline where aquifers become exhausted and/or urban populations and industry claim a growing share of limited water resources. Nevertheless, more than half of additional crop production by 2010 is expected to come from irrigated land, according to FAO projections. This implies the need for vigorous, renewed investment in small-scale irrigation schemes which can raise yields while minimizing economic costs and environmental damage.[16]

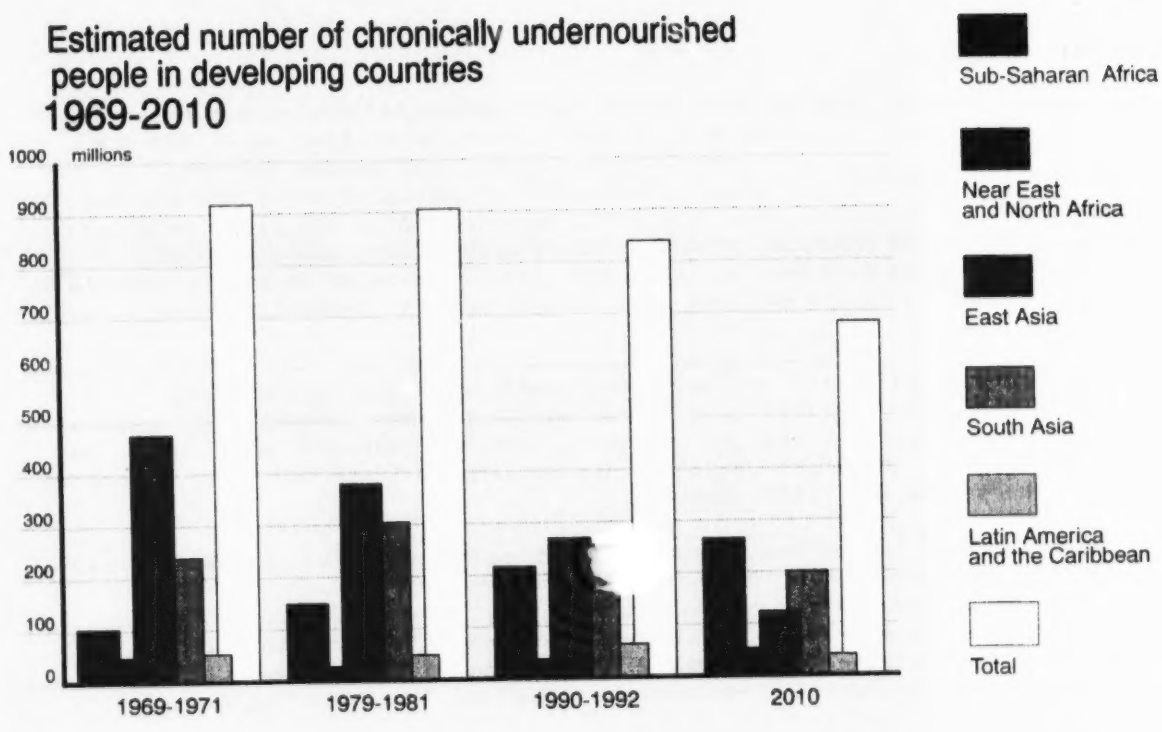
Agricultural productivity and food security

102. The CDS, IFPRI and FAO forecasts all suggest that future production gains will be sufficient to cope with increased population and rising demand at the global level. At the regional level, however, they all indicate worsening food insecurity in sub-Saharan Africa and only marginal improvement in South Asia, even under a variety of assumptions about future growth, investment and trade liberalization. It seems unavoidable that food security in some developing countries will (as now) depend on imports from food surplus to food deficit countries. On the basis of current policies, nearly 700 million people are expected to go hungry in 2010 (figure IV.5).

103. In theory, there is scope for further immense yield gains and raised production in the future. Wide disparities still exist between the yields achieved in agricultural research stations and by farmers. Typically, dryland farmers in Asia, Latin America and Africa obtain between one tenth and two thirds of research station yields; most farmers achieve less than half. In addition to yield gaps in improved crops, many plant and animal breeds have not yet been subject to much scientific improvement. However, a major challenge will be to ensure that future improvements do not exclude tropical farmers - where potential production gains are high and food insecurity is often greatest.

104. The CDS and IFPRI scenarios represent a "mid-way" point between technologically based projections which recognize few limits to food production and more pessimistic forecasts founded on the belief that world food production is already on a declining trajectory. If historical improvements in agricultural productivity can be maintained, there will be enough food to meet expanding demand. Future improvements will depend critically on continuing investment in improved crop varieties, greater efficiency in water use, improved soil management and socio-economic development which enables farmers to take advantage of new techniques.

Figure IV.5



Source: FAO, World Food Summit, 1996

The role of policy

105. Agriculture is a heavily regulated economic sector. National Governments in both developed and developing countries intervene to influence what is grown and sold, where and how. Trade policies determine market access and can be used to protect the interests of domestic producers. The potential for government action to improve, or worsen, food security at every level is therefore enormous.

Positive impacts ...

106. Countries which have followed broad-based economic development strategies including high levels of investment in agriculture have often experienced a number of positive benefits: increased employment and income through agriculturally led economic growth, decreased incidence of rural poverty and greatly improved food security. The World Bank has noted the clear relationship between rising gross national product (GNP) and declining prevalence of underweight children between the 1970s and 1980s; the relationship is especially strong in countries that have done well in agriculture, such as Indonesia and Thailand.[17]

107. More specifically, the extraordinary yield increases of the Green Revolution were made possible by a technological package (comprising genetically improved plant varieties, irrigation, fertilizer and pesticide application and management skills) developed by scientists working in State and donor-sponsored research institutes and field stations.

108. Public demand for nature conservation, together with budgetary constraints, have encouraged "environment friendly" policy measures to reduce agricultural surpluses and improve environmental protection in some developed countries. Strict regulation and pricing incentives have been introduced in parts of Scandinavia and Northern Europe, for example, which limit the use of agrochemicals and encourage preservation of habitat "enclaves" in farmland.

... and negative impacts

109. It has been argued that market failures in the agriculture sector and government interventions which distort product and input prices (and tend to reinforce market failure) have a greater effect on soil, water, human health and ecosystems than equivalent failures in any other sector.[18] Examples abound in both developed and developing countries of tax incentives which have encouraged inappropriate changes in land use. Subsidies in many developing countries for pesticides and herbicides, combined with inadequate education and product labelling, have encouraged excessive use, leading to soil and water contamination and thousands of pesticide-related deaths per year. The Common Agricultural Policy (CAP) of the European Union at one time involved a system of guaranteed prices for unlimited production. These guarantees improved regional self-sufficiency and turned Europe from a net importer to a net exporter of cereals. At the same time, they encouraged intensive farming methods which have led to soil and water pollution, landscape degradation and loss of biodiversity.

110. At the global level, agricultural production and trade patterns have been seriously distorted by national and international policy responses to the macroeconomic events of the 1970s and 1980s: the oil shocks, the boom and bust cycle in food commodity prices, developing country indebtedness and world recession. One notable impact was that agricultural policies adopted by OECD countries during the "boom" years of the 1970s protected their farmers from fluctuations in world markets. When commodity prices plunged in the 1980s, domestic price supports, particularly in the United States and Europe, were generally maintained, leading to massive over-production and export subsidy programmes. This further depressed both world prices and the incentives for developing countries to produce for either domestic consumption or export.[19]

Policy lessons and priorities

111. The fundamental challenge for sustainable agriculture and future food security is to make better use of available physical and human resources. Dramatic gains in agricultural productivity have proven possible to achieve but some regions remain at least partially "locked" in the low-input, low-output phase of the agricultural transition, unable to capitalize fully on available, superior crop varieties and management techniques. Sub-Saharan Africa especially has not benefited as expected, or has not sustained early gains. The experience of the Green Revolution has shown a number of elements to be critical to more widespread success.

112. Maintaining, or improving on, current trends in yield gains will depend on continued investment in agricultural research, preservation of biological diversity, both *in situ* and in gene banks, and substantial increases in fertilizer use in many developing countries. Donor funding remains critical for the foreseeable future: the IFPRI scenarios estimate that if international donors were to eliminate all funding of national and international agricultural research, food grain production would drop by 10 per cent and the number of malnourished children in developing countries would increase by 32 per cent. Conversely, if donor funding were to increase by 50 per cent, food grain production would increase by 40 per cent and the number of malnourished children would drop by 30 per cent.[11]

113. Technological improvements will not be sufficient, however. The continuing gap between yields achieved by many farmers and at experimental stations suggests that more emphasis must be put on creating thriving rural economies which provide enabling environments for small farmers. Success factors include improved land tenure, remunerative prices, access to credit and markets that, together, encourage farmers to adopt new agricultural crops and techniques.[20]

114. While market reforms are important, the experience of structural adjustment programmes undertaken by many developing countries as a condition of internationally funded assistance has served to demonstrate that the pursuit of more market-oriented policies does not automatically cause agricultural production to rise in the short term, or the numbers of hungry to fall. More attention is now being paid to the need for complementary policy measures such as the provision of agricultural extension services and facilitating greater participation by programme beneficiaries, especially women.

115. Degradation of the agricultural resource base through soil erosion, loss of cropland to development and contamination of soil and water by agrochemicals must be slowed and, where feasible, reversed. Food supplies in the future will come largely from higher yields on existing agricultural land, and losses of productive land must be compensated by even greater increases in yields. The more land lost, the greater the technological and economic challenge will be. Better management of irrigated land is a particular priority in this regard (chap. V). Policy-making in all countries has too often paid insufficient attention to the protection of agricultural land as a natural resource, suggesting the need for re-evaluation of the economic costs of soil degradation due to poor agricultural practices or land loss from unplanned development.

116. Agricultural productivity gains in many poor and food insecure countries have often been undermined by high losses caused by pest damage in the field and post-harvest losses from inadequate transport and packaging systems. This, in turn, has led to heavy reliance on pesticides, which have compromised human health and ecosystems in many regions. The most feasible alternative remains intensified development and use of integrated pest management (IPM) systems, including both biological and chemical controls. Cooperation between public authorities and the private sector, especially newly emergent biotechnology companies, will be required.

117. The prospect of future regional imbalances between food supply and demand suggests that the developed countries will increase production again in order to meet global needs, but this will occur only in response to rising prices on international markets. If food subsidies to urban consumers in developing countries were reduced, and food prices allowed to rise, the necessary economic incentives might be supplied.

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V. WATER: A MULTIFUNCTION RESOURCE

Introduction

118. The United Nations Water Conference of 1977 covered a wide range of water management issues but is now chiefly remembered for its call to provide safe drinking water and adequate sanitation for all. The Mar del Plata Action Plan, which stemmed from the Conference, and the subsequent International Drinking Water Supply and Sanitation Decade (1981-1990), set out to implement this goal. The provision of services increased substantially over the decade but progress was slowed by the macroeconomic difficulties experienced by many developing countries in the 1980s and by population growth which offset many of the gains.

119. Throughout the 1980s and 1990s, concerns over water quality came to be matched, and in some countries dominated, by the issue of water supply; in particular, the increasing incidence of regional and local scarcity and conflicts over access to limited water resources. Faced with steadily rising consumption, many Governments struggled to meet the demand by raising supplies to match - whatever the cost. An era of gigantic water engineering projects was initiated in the 1950s but peaked by the late 1980s, when protests over their environmental and social impacts, and soaring economic costs, slowed the rate of construction.

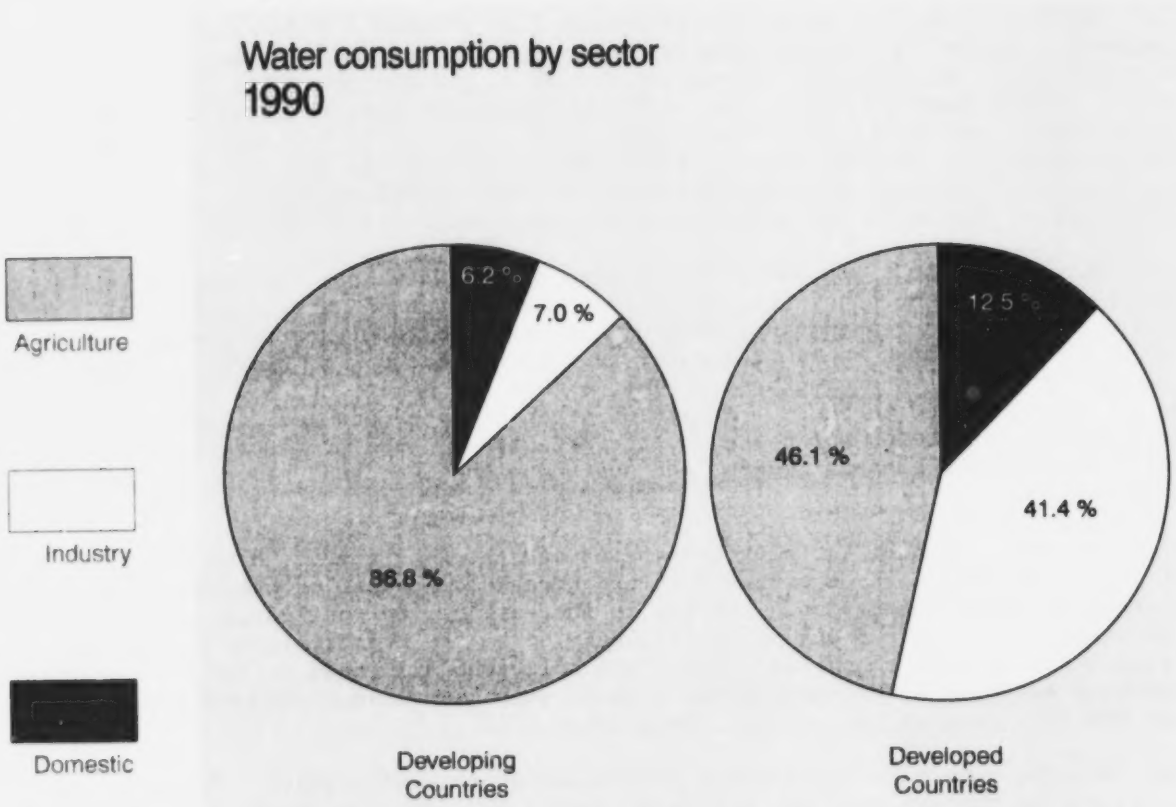
120. The International Conference on Water and the Environment, held in Dublin in 1992, and Agenda 21 demonstrate international acceptance of a broader and more complicated water agenda. Water is increasingly recognized as a finite and vulnerable resource and one which is likely to be the principal constraint on development in some countries. Long-term solutions will need to focus more on managing water as an economic good, with an emphasis on increased efficiency of use and more rational allocation among users.

121. Equally, water quality issues have taken on renewed urgency. To humanitarian concern over the suffering caused by inadequate water supply and sanitation services, has been added the realization that pollution of water resources is reducing usable supplies and aggravating the scarcity problem. Thus quality and quantity issues have merged in a way that reinforces the need for a more integrated approach to water policy.

The water transition

122. Socio-economic development is characterized by more active exploitation of water resources. Water is a critical input to both industry and agriculture and economic growth usually requires transfers of water from moist to dry areas and construction of dams and reservoirs for hydropower, irrigation, flood control and seasonal storage. Water pollution from industrialization and urbanization also tends to increase in the early stages of development. Historically, as countries industrialize, the share of water used for agriculture declines and an increasing proportion is taken by the industrial, commercial and household sectors - domestic consumption, in particular, increases greatly with more affluent lifestyles (figure V.1). Worldwide, agriculture still consumes about 70 per cent of available water supplies, with a range from under 5 per cent in

Figure V.1



Source: Based on Raskin, Hansen and Margolis, Stockholm Environment Institute.

some northern European countries to over 90 per cent in parts of Africa, South America and central Asia.

123. There is, however, no clear relationship between per capita water use and national wealth. Higher per capita household and industrial use in rich countries tends to be offset by lower use rates in agriculture. The exception is found in the very poorest countries, which also have the lowest per capita use rates. One encouraging development is that newly industrializing countries appear to be moving towards relatively more efficient patterns of water use more quickly than did the old industrial economies. As with energy use (chap. III), rising per capita income in some higher-income developing countries is characterized by lower per capita water consumption in the industrial and household sectors than was the case in the past.[1]

Water: the question of supply and demand

124. Fresh water supplies are renewable (through precipitation, river inflow and groundwater recharge) but finite; the world's water is a fixed stock. The total human demand for fresh water has risen steadily with increasing population and economic activity. Since 1940, global water withdrawals have risen by an average of 2.5 per cent annually - faster than the rate of population growth (figure V.2). Humanity now uses, directly or indirectly, more than half of the world's water supply that is accessible and per capita availability of fresh water worldwide fell from 17,000 m^3 in 1950 to 7,300 m^3 in 1995.[2]

125. Globally, fresh water is abundant but it is very unevenly distributed among and within countries. Chronic water shortages already exist in many areas where precipitation is low or unreliable and/or where withdrawals have been significantly increased to meet additional demand from expanding irrigation, industry or urban populations. In addition to pressure on water resources from economic development and changes in social consumption patterns, water supply is increasingly constrained by land use changes (for example forest clearance, which tends to increase run-off and reduce water availability) and contamination from human settlements, industry and agriculture.

126. In most recent analyses, countries are considered likely to experience chronic scarcity problems when water availability falls below a "benchmark" of approximately 1,000 m^3 per person per year. However, a recent major assessment of the world's water resources (the Global Water Assessment)[2] has refined this measure and defined water stress as the ratio of water withdrawal to water availability on an annual basis. A ratio of less than 10 per cent indicates few water resource management problems; a range of 10 to 20 per cent indicates that water availability is becoming a limiting factor and significant investments will be needed in the future; water withdrawals exceeding about 20 per cent of available water indicate that management of both supply and demand will be needed and that resolution of competing uses will be necessary to assure sustainability.

127. Viewed in this way, issues of water demand, and actual or potential water scarcity, are intimately connected not only to population growth but also to the structure of an economy. Decision-making that favours or inhibits alternative uses of water critically affects whether or not a country will be water-scarce at any given level of water availability. Countries where current water use patterns are creating stress or scarcity in at least some part of their territory are identified in figure V.3.

Figure V.2

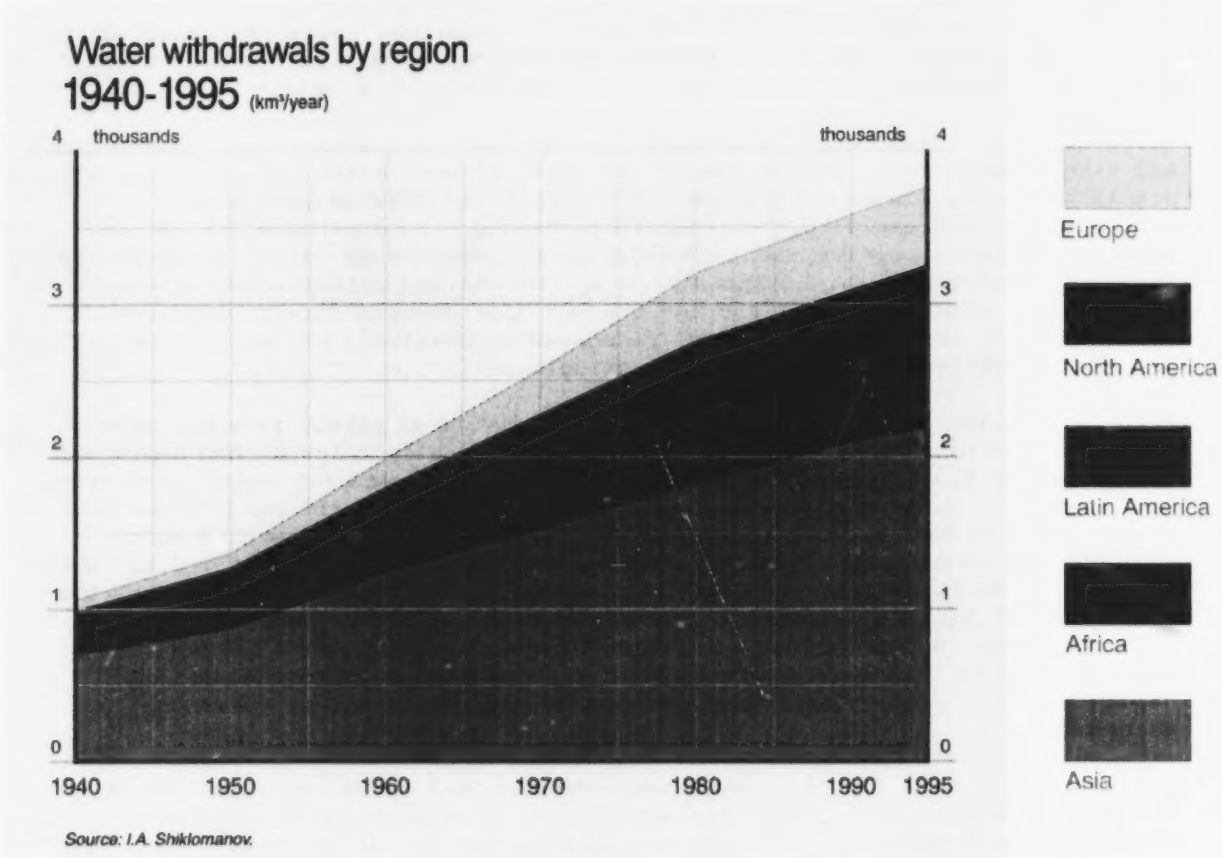
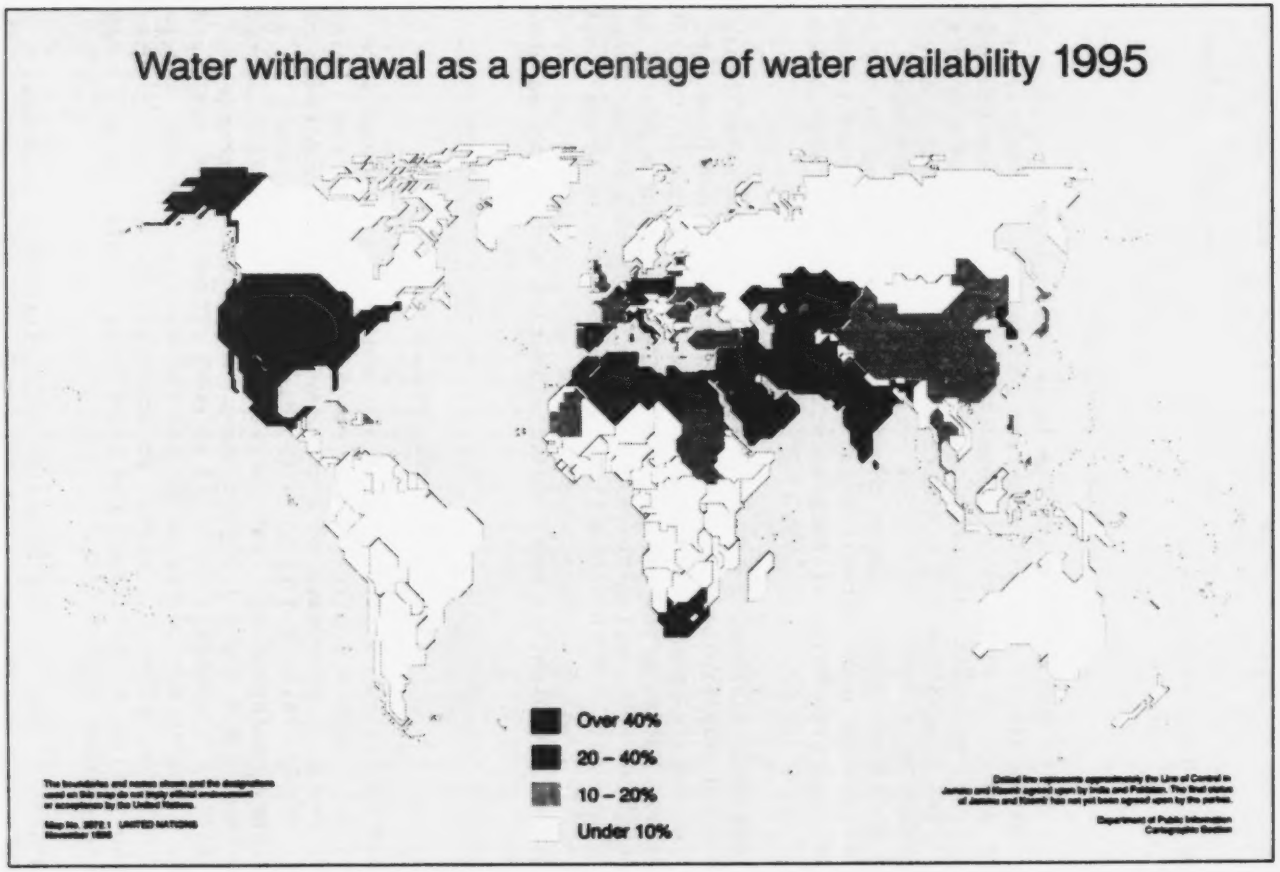

Water withdrawals by region
1940-1995 (km³/year)
thousands
thousands
4
3
2
1
0
1940
1950
1960
1970
1980
1990
1995
Europe
North America
Latin America
Africa
Asia
Source: I.A. Shiklomanov.

Figure V.3


Water withdrawal as a percentage of water availability 1995
Over 40%
20 – 40%
10 – 20%
Under 10%

128. Many water-stressed countries have been forced to turn to their groundwater reserves, which are frequently pumped faster than they can be recharged. Such water "overdrafting" is widespread in parts of India, China, Mexico, the United States and the former Soviet Union. Parts of Northern Africa and the Middle East are dependent on withdrawals from "fossil aquifers" which are not recharged at all. Given the rising costs and declining availability of new sources of water supply, some regions may need, over time, to reorient their economies towards less water-intensive end uses.

Competition and conflict

129. A notable trend in the past decade has been sharpening competition between rural and urban water users, over both surface and groundwater resources. When shortages become acute, it is usually (though not always) farmers who lose, since their economic and political lobbying power tends to be less than that of urban and industrial constituents. A number of developed countries are attempting to manage an orderly shift from rural to urban use through reallocation of water use rights, water trading and even schemes to buy out farmers and redistribute their water rights.[3] However, there could be serious implications for food production if such solutions are adopted more widely (chap. IV).

130. At the international level, conflicts are focused at the river basin level. They have arisen with increasing frequency over projects to dam or divert water by countries in a powerful position upstream of their neighbours. Current flash points include cross-border river basins in South America, North Africa and the Middle East, though an encouraging 30-year cooperation agreement has recently been signed in South Asia. Future conflicts are a potent risk where countries sharing river basins combine circumstances of low water availability, rapidly growing populations, urbanization and industrialization and continued absence of regulation.

Water and human health

131. In developed countries, drinking water and sanitation services were extended to most major urban centres by the early twentieth century, bringing immediate and dramatic improvements in life expectancy. The importance of high quality water to human health and the healthy functioning of society is evident in current environmental spending: water treatment represents the largest item in pollution abatement and control expenditures in the OECD countries.[4] Infectious diseases have steadily declined in most cities in the developed world. However, despite near universal access to sewerage systems, sewage is not necessarily treated before discharge; an estimated 30 per cent of wastewater in developed countries is still dumped raw into local rivers, lakes or marine waters, posing increasing health risks.[5]

132. There is evidence that developing Asian countries are successfully providing adequate sanitation services at lower per capita income levels than was the case in the developed countries.[6] However, in many other developing countries, worsening water quality represents one of the most serious health

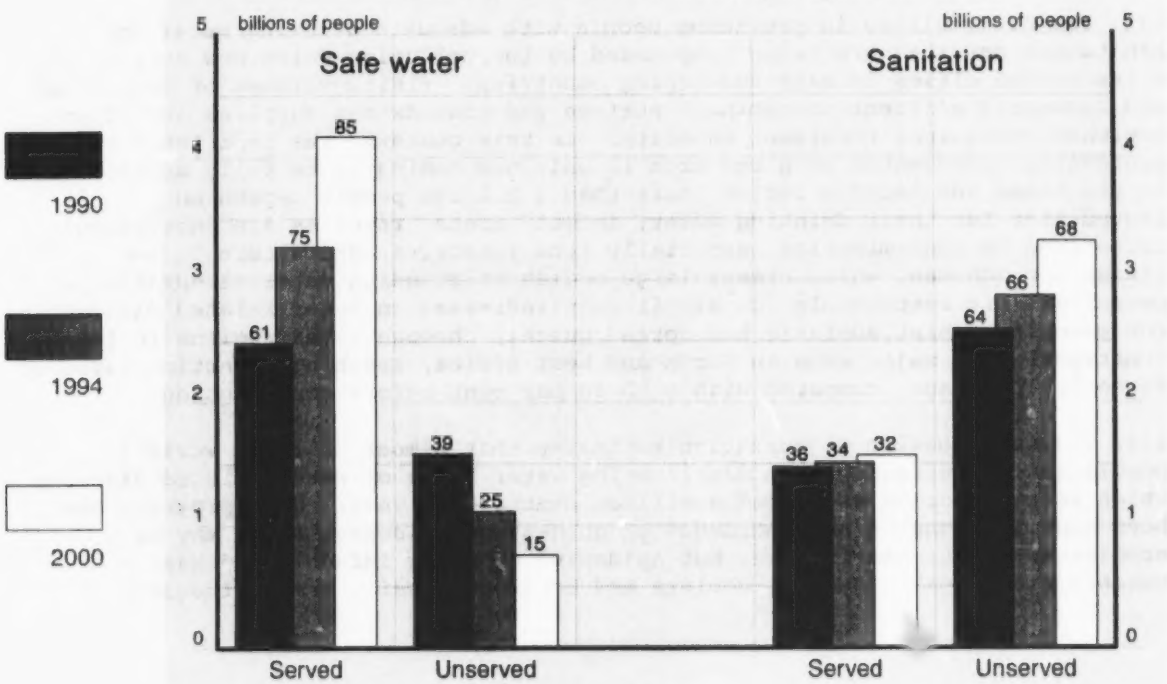
hazards and constraints on socio-economic development. The International Drinking Water Supply and Sanitation Decade (the "Water Decade" 1981-1990) was a coordinated international effort to "speed up" the water quality transition and accelerate the introduction of water services in poor regions. Nearly US$ 100 billion was invested but the results were mixed. Impressive gains in the numbers of people served were offset by population growth, especially in urban areas. In 1994, approximately 1.2 billion people in developing countries lacked safe water supplies and nearly 3 billion lacked access to sanitation services, representing a decline in the percentage of the population served (figure V.4).[3]

133. The difficulties in providing people with adequate drinking water and sanitation services are being compounded by the pollution which now extends for miles around cities in many developing countries: rising volumes of industrial and household effluent contaminate surface and groundwater supplies and often overwhelm municipal treatment capacity. In this context, the importance of protecting groundwater as a resource is only now coming to be fully appreciated. In the Asian and Pacific region, more than 1 billion people depend on groundwater for their drinking water; in many areas, reserves are increasingly threatened by contamination, especially from intensive agriculture.[7] New irrigation schemes, which create large bodies of standing water favourable to parasites, are responsible for significant increases in water-related diseases. For example, schistosomiasis has spread quickly through river regions following construction of major dams in North and West Africa, reaching infection rates of 90 to 100 per cent, compared with 5 to 10 per cent before construction.[8]

134. The World Health Organization estimates that almost half the world's population is suffering from debilitating water-borne or water-related diseases which account for an estimated 5 million deaths each year. Good progress has been made in reducing the incidence of guinea-worm disease, which may be eradicated in the near future, but epidemics of other infectious diseases, notably diarrhoeal diseases, cholera and schistosomiasis, remain frequent.

Figure V.4

Access to safe water and sanitation services in developing countries



Source: Based on report of the Secretary-General (A/50/213).
Note: Numbers above bars indicate percentages of the population.

Water and ecosystem functions

135. Worldwide efforts to increase available water supplies have involved major trade-offs: natural capital has been lost, in return for gains in energy generation, food production and socio-economic development. The past half century has witnessed an unprecedented period of construction of dams, canals, reservoirs and pipelines. The number of major dams (over 15 metres in height) in the world rose from just over 5,000 in 1950 to nearly 38,000 today, with over 60 per cent in Asia.[9] This "plumbing" of the world's river systems, though essential in some cases, has led to multiple environmental and social impacts, some of which are now recognized as serious obstacles to future development.

136. In many of the world's great rivers, the volume and timing of water flow is almost entirely controlled, with virtually no water reaching the sea. This has resulted in major disruptions to aquatic habitats, declining fish stocks and significant losses in biodiversity. Another important objective of water engineering is flood control. Ironically, there is evidence that flooding is worsening in some regions due to excessive canalization of rivers and loss of wetlands which act as natural sponges. Successful flood prevention, on the other hand, is preventing replenishment of deltas and fertilization of flood plains worldwide because silt tends to be trapped behind dams in reservoirs. Global loss of reservoir capacity due to sedimentation is estimated at 10 per cent per decade.[2] Loss of productive land as deltas retreat is a problem which could be compounded by climate change and rising sea levels. For example, it has been estimated that Egypt could lose up to 19 per cent of its habitable land, displacing some 16 per cent of the population, over the next 60 years.[10]

137. Major concerns arise over waterlogging and salination of soils caused by poor irrigation techniques. Irrigation has accounted for more than half of the increase in global food production since the mid-1960s and is expected to contribute strongly to meeting future additional demand (chap. IV). However, about 20 per cent (50 million hectares) of the world's irrigated land is affected, to some degree, by soil degradation caused by faulty irrigation practices.[2] In many areas, salination has reached the point where food production is significantly reduced; studies have found that yields of major crops in North Africa and parts of Asia are being cut by 30 per cent.[10]

138. The trend to ever bigger water engineering projects has slowed in the 1990s due to low food prices (which discourage the expansion of irrigation), rising real costs of construction and growing recognition of the environmental and social consequences. Much of the damage due to misuse of water resources could be reversed, given time, political will and finance. The more fundamental problem is that, despite all the effort put into storing and transporting fresh water, supply side solutions have not kept pace with rising demand in many water stressed countries. This suggests the need for alternative approaches if future demands are to be met.

Looking ahead

139. Water management over the next decades will be a development issue (ensuring water supplies are sufficient for economic activity without undermining the natural resource base of soil and water), a political issue (avoiding domestic and international conflicts over a scarce resource) and a welfare issue (providing people with the water services necessary for good health and quality of life). Projections regarding future water demand and availability are highly uncertain, being dependent on assumptions about population and economic growth, investment in additional water supply, relative demand from different consuming sectors, the development and adoption of new technologies and the extent to which existing supplies become contaminated.

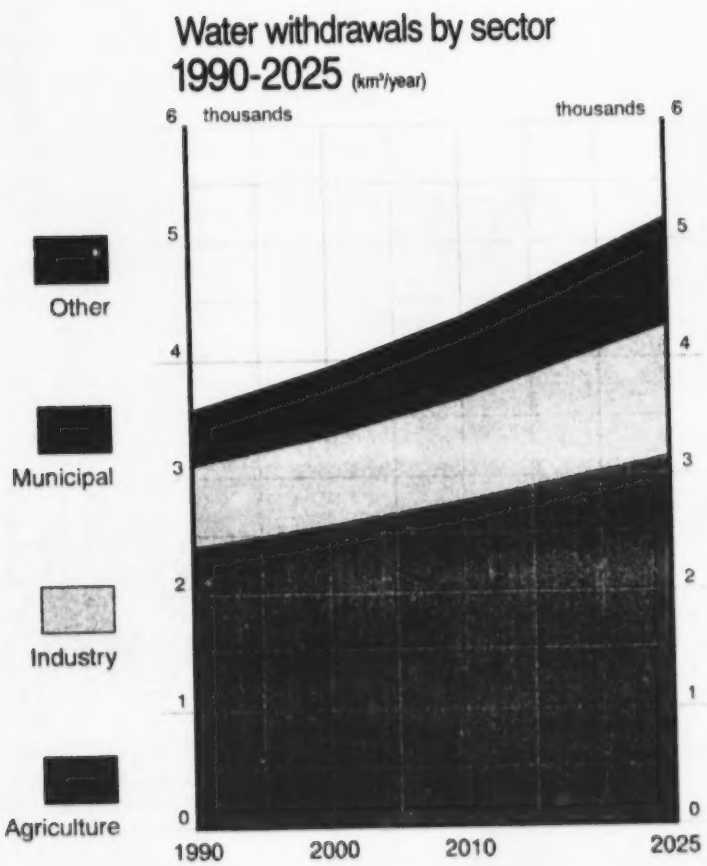
140. Projections made in the recent Comprehensive Freshwater Assessment (see note 2 below) are based on the United Nations medium population growth forecast and assume no major changes in policy or technology; they represent a business-as-usual continuation of present trends. Estimated withdrawals reach a global total of over 5,000 km^3 per year by 2025 (figure V.5).

141. The Conventional Development Scenario projects a much lower rate of increase, based on greater shifts worldwide towards less water-intensive economic activities and higher levels of water efficiency. Its estimate of total withdrawals of 4,300 km^3 by 2050 is considered very conservative by most experts. At the opposite extreme, another estimate has been produced as a "backcasting" exercise, based on FAO projections of future food demand; it represents the amount of water that would be required to produce sufficient food for the world's population in 2025. Depending on water efficiency in agriculture, and other factors, estimates of this variant range from a 50 to 100 per cent increase in water demand over the next 30 years.

142. Future water supplies in many developing countries could be critically determined by contamination of rivers, lakes and groundwater reserves by industrial emissions and agricultural and urban run-off. Agricultural use of fertilizers and pesticides is expected to increase rapidly in developing countries in order to meet rising food demand and, if inadequately managed, industrial growth and urbanization will produce dramatic increases in pollution. The extent to which societies will choose to limit water withdrawals for economic purposes in order to protect terrestrial and aquatic ecosystem functions is a further uncertainty, especially in industrializing countries where standards of living and interest in environmental quality are rising rapidly.

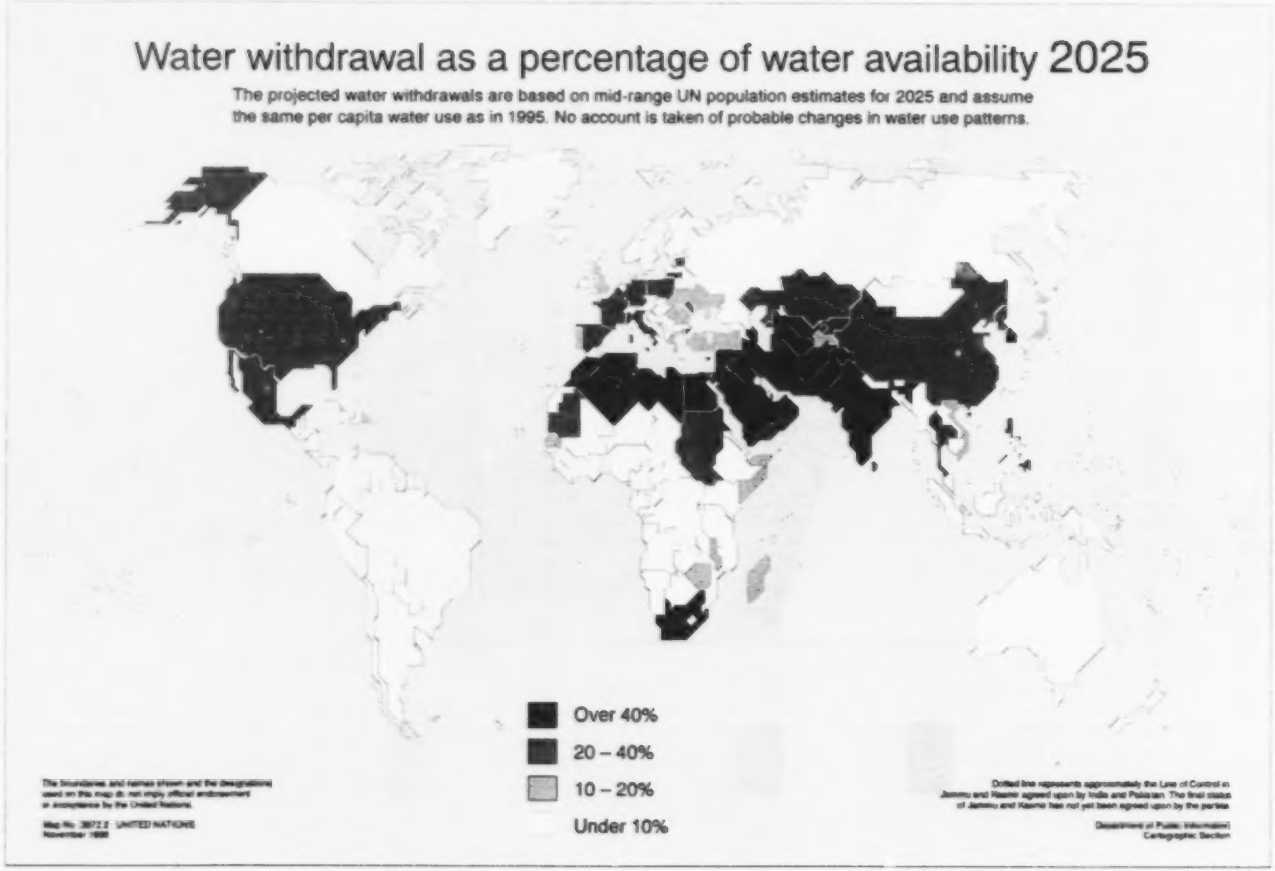
143. Despite their wide range, most forecasts of water use suggest that demand from all economic sectors will continue to grow. On current trends, almost two thirds of the world population in 2025 will be subject to moderate to high water management difficulties, and almost half the world will have difficulties in coping due to inadequate financial resources. Figure V.6 illustrates the projected water stress index for countries in 2025; it is a conservative estimate, which assumes that per capita water withdrawals remain at 1995 levels.

Figure V.5



Source: I.A. Shiklomanov.

Figure V.6


Water withdrawal as a percentage of water availability 2025
The projected water withdrawals are based on mid-range UN population estimates for 2025 and assume the same per capita water use as in 1995. No account is taken of probable changes in water use patterns.
Over 40%
20 – 40%
10 – 20%
Under 10%
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.
Map No. 3972.1 UNITED NATIONS
November 1998
Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.
Department of Public Information
Cartographic Section

144. It appears most likely that water will become a critical issue in development. Worldwide, water use cannot rise to match projected demand without a substantial increase in available supply, much greater use of the existing supply and major efforts to prevent pollution. Where increasing available supply to match demand is economically and/or environmentally infeasible, the emphasis must be on water conservation and pollution prevention. Conservation - especially water reuse in industry and greater efficiency in household and agricultural use - represents the greatest "resource" still to be exploited.

The role of policy

145. Water has traditionally been a State responsibility in most countries. Viewed as a strategic resource but also a public good, water resources have tended to be centrally planned and protected from market forces. Politically, major projects to increase water supply have often proved more attractive than measures aimed at water conservation and efficiency.

146. Political and social considerations have encouraged Governments worldwide to provide large subsidies to insulate water users from the true costs of provision. The World Bank estimates that, on average, municipal water users in developing countries pay about 35 per cent of the average cost of water supply. Developed country Governments also subsidize municipal users though generally at a lower rate than agricultural users. In both developed and developing countries, most urban water utilities further distort prices by charging flat or declining rates per unit of water use, rather than rates that rise to reflect increasing marginal costs of supply.

147. Worldwide, water subsidies benefit farmers above all other users; farmers typically pay between 10 and 20 per cent of the construction and operating costs of irrigation projects.[11] Artificially low water prices largely underwrote the worldwide boom in irrigation and thereby enabled essential increases in agricultural production. However, they also encouraged the development of wasteful and inefficient practices; on average, 55 per cent of irrigation water never reaches the crop.[12] Generous allocation of subsidized water to agriculture - while helpful for food security, rural poverty alleviation and increased agricultural exports - may not be the most economically beneficial option overall. Planners in China calculate that a given amount of water used in industry generates more than 60 times the value of the same amount used in agriculture.[10]

148. Water management at the national level is characterized by fragmentation of responsibility, for example, among ministries of agriculture, energy, health, transport, environment, economic affairs and local authorities. Despite some evidence of a move towards integration - linking water legislation to economic and social issues - weak and divided administrative structures persist in many countries. Isolated decision-making in one sector can create problems - or foreclose future options - in another. This has especially been the case in decisions relating to major irrigation schemes: the over-ambitious attempt to irrigate much of the Aral Sea Basin has led to economic, environmental and human health damage totalling an estimated 37 billion roubles; wide areas have been economically ruined.[13]

Policy lessons and priorities

149. There is a growing consensus that increasing water supplies to match demand will, in many areas, be economically prohibitive. Costs of tapping new water supplies are projected to rise to between two and three times the cost of current investments.[6] A prime lesson of recent years, therefore, is recognition that improved management and greater efficiency are the keys to stretching water resources. Two broad policy approaches hold particular promise: (i) institutional change to encourage more integrated and effective water management and (ii) technical innovation and pricing reform to improve efficiency of use and manage demand.

150. Some countries are beginning to decentralize their water supply services and give a greater role to the private sector. Municipal authorities in most regions of the world are experimenting with some transfer of water management to private companies, autonomous utilities or water user associations in the hope of improving cost and water efficiencies and standards of service.[14] Top priority needs to be given to providing safe drinking water and sanitation in Africa, Latin America, Asia and the Pacific region. However, a prime lesson of the Water Decade has been the inappropriateness of transferring developed country standards wholesale to developing countries. Western infrastructures have developed over more than a century, in step with economic and population growth. The size of population and budgetary constraints in many developing countries mean that providing all residents with, for example, piped water and flush toilets in their houses is not a realistic option in the near term. Low-cost solutions, tailored to local conditions and needs, are proving themselves effective but are commonly resisted on the grounds that they represent a low-technology, second-rate development route.

151. In rural areas, watershed management is being promoted as a means to more integrated management of water, forest and agricultural land resources. A number of Governments and international aid agencies are supporting innovative attempts to promote joint management of watersheds by local residents and government agencies. In northern Thailand, for example, an approach has been developed involving community mapping of watersheds, a physical model of the watershed area that serves as a basis for a joint zoning exercise and the development of a network of participating communities within the watershed to deal with transboundary issues.[15]

152. The growing number of cross-border conflicts over water supplies clearly requires shared water resources to be developed on a more cooperative basis in the future. International agreements regulating water use in shared river basins are common in developed countries and they are slowly being replicated in developing countries.[16] Despite the complexity and political sensitivity of such agreements, the international community has recently made some progress in assisting countries to develop integrated action plans for the management of shared water resources. The importance attached to this issue at the international level, however, does not match its strategic significance.

153. Water-efficient technologies hold enormous potential for relatively low-cost expansion of available supplies. This is particularly true in the agriculture sector; it has been estimated that saving and transferring just

5 per cent of agricultural water to municipal uses in the western United States would meet the needs of urban users for the next 25 years.[17] However, this option is still grossly under-exploited. While the use of water-efficient drip irrigation has grown 28-fold since the mid-1970s, it is still employed in less than 1 per cent of the world's irrigated area.[10]

154. In the industry and household sectors, efficient appliances, demand management and conservation measures can be effectively encouraged with economic incentives. The introduction of effluent charges in a growing number of countries has stimulated industries to recycle and treat their water intake, causing their overall use rates to decline, sometimes dramatically. Numerous studies demonstrate the link between rising prices and declining demand and consumption rates. However, increasing water prices to cover the full costs of provision is a politically daunting step even in the wealthiest countries and currently infeasible in most of the developing world. In Europe, for example, Governments have sought to raise water tariffs (sometimes in the context of privatization) in order to meet the costs of investments in new infrastructure required under European Union law. Public reaction has often been hostile and water use has not declined where new rates have not been linked to consumption. In developing countries, full cost pricing is a realistic goal only in the long term. Price rises are likely to be effective only in the context of institutional reforms that encourage efficient allocation and services and broader socio-economic development which fosters both responsible use and the ability to pay. The transition will require time and careful management.

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VI. HUMAN DEVELOPMENT

Introduction

155. Core elements of a human development "package" were set out for the first time in the 1948 Universal Declaration of Human Rights. The Declaration recognized specific social and economic rights such as access to education, health, political participation and a decent standard of living, as well as more intangible rights, including freedom, personal security and dignity. These rights, and principles for their implementation, have since been elaborated in international meetings and conventions, culminating in the recent series of global conferences organized by the United Nations on such developmental issues as population, the environment, poverty and the status of women.[1]

156. For many years, economic growth has been seen as the key to achieving most human development goals. Rapid economic growth over much of the past half century has enabled many countries to make great progress in providing their citizens with reasonable living standards. However, population growth, macroeconomic difficulties and inadequate political and social infrastructures have impeded progress in many lower-income countries, leading to a sense of "running to stand still". At the same time, serious concerns have arisen over the long-term viability of some current growth patterns. One set of concerns focuses on the environmental, economic and social consequences of the resource-intensive consumption patterns of the developed world - and, increasingly, the rapidly industrializing countries - another on the multiple problems bound up with economic stagnation, poverty and environmental degradation in some developing countries.

157. The concept of "sustainable development" has contributed two fundamental ideas to this debate. Firstly, if human development is to be sustained in the long term, societies cannot afford to pursue economic growth in a manner which destroys the natural resource base on which present and future economic activity depends. Secondly, the benefits of economic growth must be distributed more equitably. Poverty undermines progress in virtually every aspect of human development and threatens security at the local, national and international levels. The 1990s have been characterized by a growing consensus that eradication of poverty represents a global priority, and one that is inseparable from socio-economic development and environmental protection.

The social transition

158. The social transition may be seen as the outcome of progress through the major transitions described so far: indicators of human development (see table) tend to rise with increasingly stable and healthy populations, rising per capita income, access to commercial energy and material goods, adequate nutrition and safe water and sanitation services.[2] At a global level, most indicators are improving significantly. The world picture, however, conceals major differences between regions and within countries. The least developed countries (LDCs) are struggling to achieve - and sustain - universal access to the basic social services; they face a serious risk of "entrapment" in which increasing populations and stagnant economic growth undermine the "take-off" in human

welfare. At the other end of the scale, many industrialized countries have established comprehensive social welfare systems, but must now contend with escalating costs as ageing populations, high and chronic levels of unemployment and social marginalization of the insufficiently skilled raise the demand for health care and payment of benefits.

Trends in human development indicators

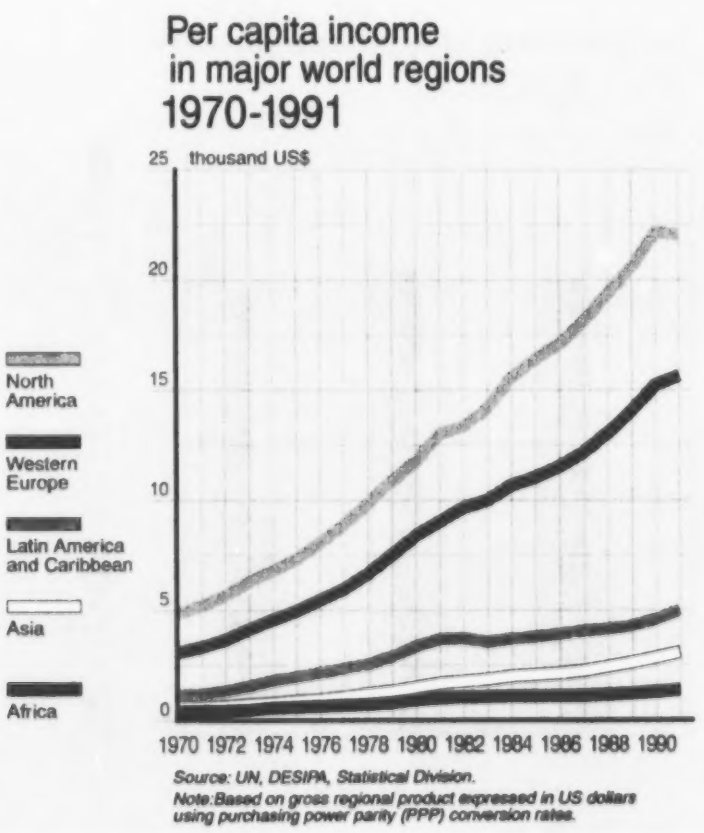
Indicator	Least developed countries	All developing countries	Industrialized countries
Life expectancy			
1960	39	46	69
1993	51	62	74
Infant mortality rate (deaths per thousand live births)			
1960	173	150	..
1993	110	70	13
Underweight children under age five (percentage)			
1975	51	40	..
1985-1995	45	30	4
Commercial energy use per capita (kg oil equivalent)			
1971	42	255	4 211
1993	50	536	4 589
Daily calorie supply per capita			
1970	2 060	2 140	3 190
1992	2 040	2 520	3 350
Adult literacy rate (percentage)			
1970	28	43	..
1993	47	71	98
Enrolment ratio, all levels (percentage, age 6-23)			
1980	31	46	..
1993	35	55	82
Real GDP per capita (PPP$)			
1960	561	915	..
1993	894	2 709	15 211
GNP per capita annual growth rate (percentage)			
1965-1980	0.4	2.9	3.1
1980-1993	0.5	3.9	1.2

Source: Based on Human Development Report, 1996 (various tables). Calorie supply data from World Food Summit, 1996.

Economic growth and poverty

159. The world economy has grown with unprecedented speed since the Second World War, and growth has been further fuelled in recent years by trade liberalization and greater mobility of private investment capital. Exports of goods and services grew from 17 per cent of the GDP of market economies in 1970 to 24 per cent in 1990. The phenomenon of "globalization" is creating a world economy increasingly interlinked by international and regional trade agreements and the operations of transnational companies, financial institutions, mass media and electronic communications. Global economic growth has led to a real rise in the standard of living for a majority of the world's population though its benefits have not been universal. While some developing regions owe their rapid growth to international trade, others, especially those dependent on exports of primary commodities, appear to be at risk of marginalization. More than 1.5 billion people experienced declining incomes in the 1990s.[3] (figure VI.1).

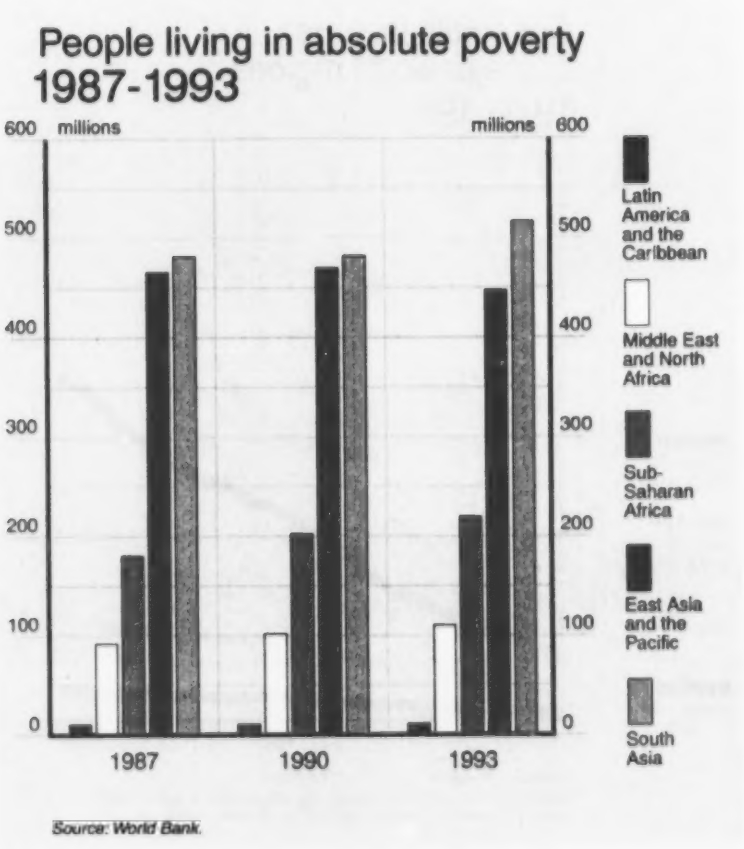
Figure VI.1



Source: UN, DESIPA, Statistical Division.
Note:Based on gross regional product expressed in US dollars using purchasing power parity (PPP) conversion rates.

160. Poverty is related to a wide range of factors, including income, health, education and access to goods and services, and such socio-cultural factors as gender and ethnicity. If income is used as a proxy measure, it is clear that much progress in reducing poverty has been made in recent decades. Average per capita incomes in developing countries have doubled in the past 25 years (a feat which took nearly 40 years in the United States). Social indicators such as education and health have also improved (see below). The percentage of the world's population living in absolute poverty (defined by the World Bank as living on less than a dollar a day[4]) has fallen since the mid-1980s. However, this decline was concentrated in Asia; other regions have not reduced the incidence of poverty to the same degree and the total number of people living in poverty has risen, to just over 1.3 billion in 1993 (figure VI.2).[5] Efforts to reduce poverty have generally met with greatest success in the developing countries which are more advanced in their economic and demographic transitions. Widespread poverty appears most persistent in countries experiencing continued, rapid population growth and economic stagnation.

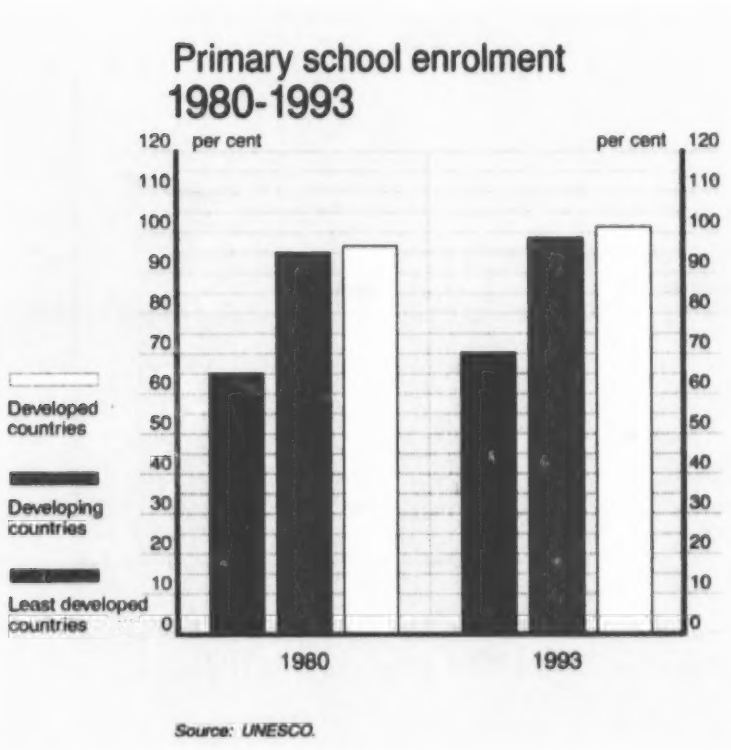
Figure VI.2



Education

161. Education is fundamental to reducing both individual and national poverty. School enrolment, especially primary schooling for literacy, is a means to achieving the interlinked development goals of health, higher labour productivity, more rapid economic growth and the broader objective of social integration, for example, through participation in political and cultural affairs. Literacy rates have risen strongly in developing countries, boosted also by adult literacy programmes, but the absolute numbers of illiterate adults has increased from about 760 million in 1970 to about 900 million today.[6] The proportion of children enrolled in school has also risen, though more slowly. The numbers of children not attending school have fallen in most of Asia and Latin America but have risen in Africa and the least developed countries.

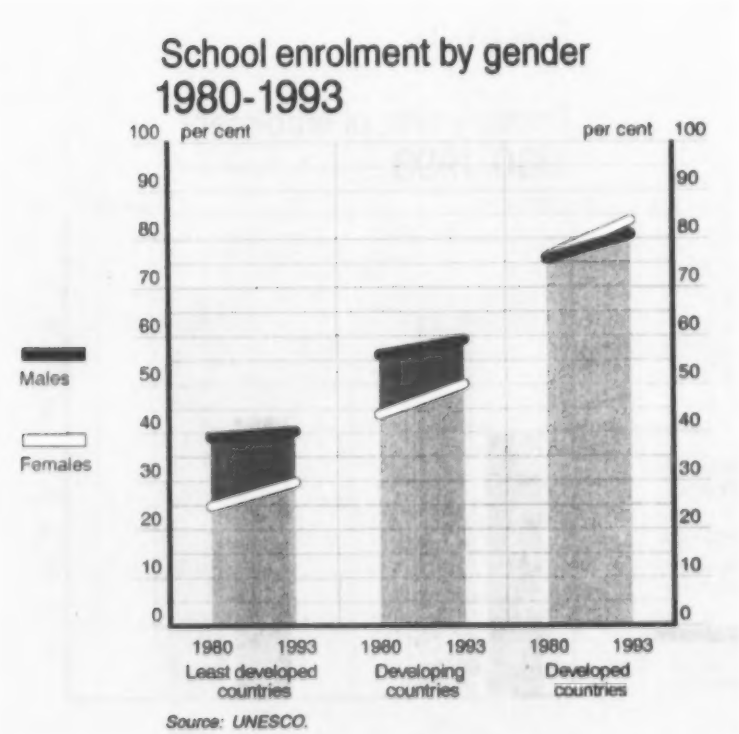
Figure VI.3



Source: UNESCO.

162. The level of education among women is increasingly recognized as a major factor in speeding the social transition; higher enrolment rates for girls demonstrably lead to decreased fertility rates, improved child health and increased earnings potential. Female adult literacy and school enrolment at primary and secondary levels increased by almost two thirds in the developing countries between 1970 and 1992, with the fastest progress being made in the Arab States, followed by south-east Asia and Latin America.[7] Progress has also been made in higher education. Overall, educational attainment among women has progressed faster than among men and the "educational gender gap", though still significant, has narrowed at virtually all levels of education and in all regions. Exceptions are adult literacy and higher education rates in sub-Saharan Africa, where the gaps between men and women have widened.

Figure VI.4

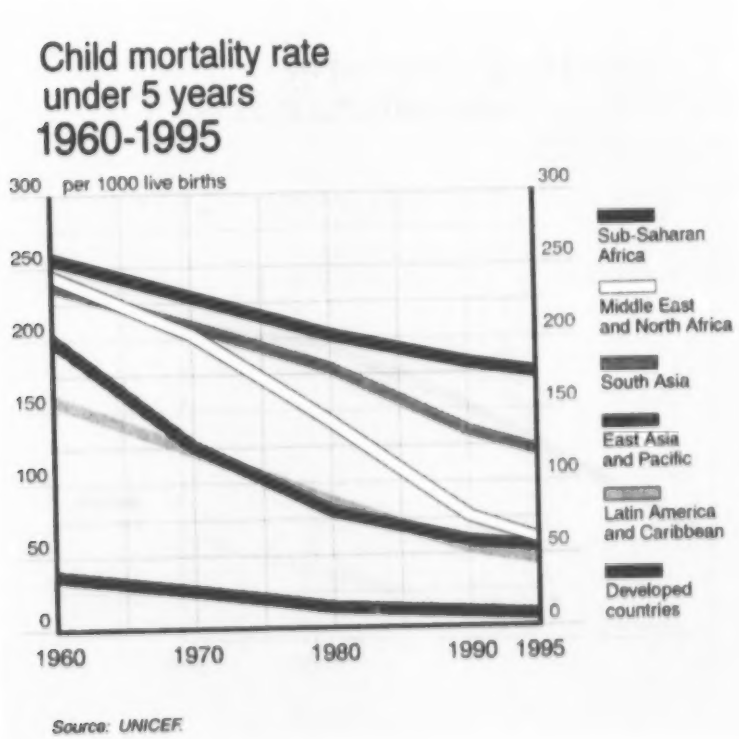


Source: UNESCO.

Human health

163. Socio-economic development is characterized by a health transition during which infectious diseases, which thrive when people live in unsanitary or overcrowded conditions, give way to degenerative diseases associated with longer life expectancy (for example, cancer) or more affluent lifestyles. Infectious diseases remain the leading cause of death worldwide (about one third of all annual deaths) but dramatic improvements have been made in recent decades. Thanks to targeted political and scientific efforts, killer diseases including poliomyelitis, leprosy, guinea-worm disease and neonatal tetanus are likely to be eradicated in the near future.[8] Globally, average life expectancy at birth has risen to 65 years and the life expectancy gap between the industrialized and developing countries has approximately halved over the past 40 years. Infant and child mortality rates have fallen in all regions.

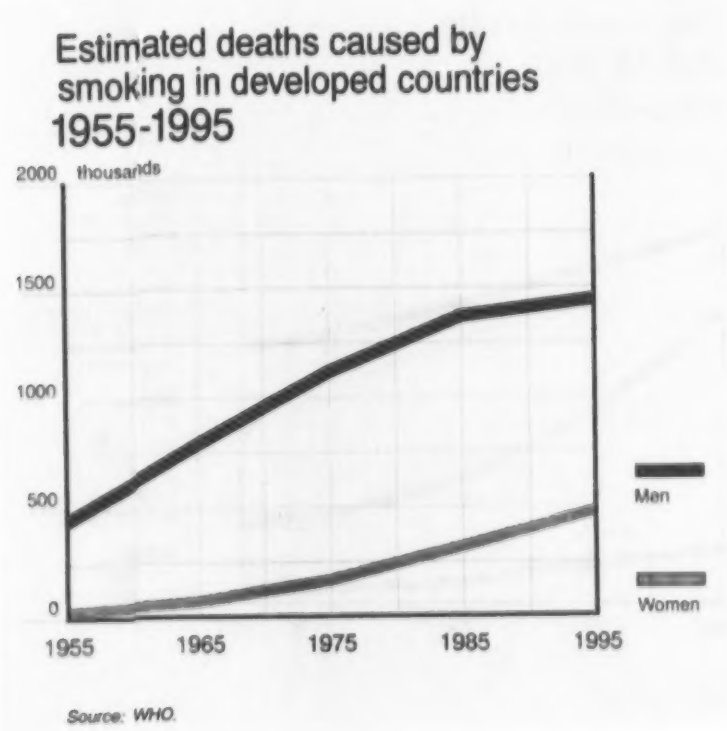
Figure VI.5



Source: UNICEF.

164. Despite progress, the World Health Organization points to disturbing trends which indicate that infectious diseases are far from under control. During the past 20 years, at least 30 new diseases - for many of which there is currently no treatment or vaccine - have emerged to pose a threat to the health of hundreds of millions of people. Examples include AIDS, which was unknown 20 years ago and has now infected an estimated 24 million adults worldwide, and new varieties of haemorrhagic fevers, of which Ebola is the best known.[6] Antibiotic resistance in hospitals worldwide is renewing the threat from diseases considered to be subdued. And, in the industrialized countries, "old" diseases such as tuberculosis have re-emerged in many poorer urban areas. Developing countries, meanwhile, are experiencing rapid growth in some degenerative diseases once largely confined to the developed world. Cancers and coronary heart disease are on the increase, especially in middle-income countries, and many more deaths may be expected from smoking-related diseases. While per capita consumption of tobacco is slowly falling in industrialized countries, it is rising in developing countries.[8]

Figure VI.6



Equity

165. Full equality of economic opportunity, access to goods and services and participation in the political and cultural life of society are not essential requirements of economic growth. However, it is increasingly accepted that gross inequities between people are not only unjust but represent a squandering of human resources and a potential brake on socio-economic development. A notable trend of the past 30 years, however, has been the widening gap between rich and poor, both between and within countries. The difference between average per capita incomes in the industrialized and developing countries tripled between 1960 and 1993, while the share of global income taken by countries with the richest 20 per cent of the world's population rose from 70 to 85 per cent.[5] Disparities in income within countries have also increased, with the richest 20 per cent of the population earning up to 30 times more than the poorest 20 per cent in some countries. Past trends in national income gaps are mixed, with moves both towards, and away from, greater income equality in the developed and newly industrializing countries. In Latin America and Eastern Europe and the former Soviet Union, income gaps have generally widened.

166. Developing countries have made good progress in some other indicators of human development. The gaps with the industrialized countries have narrowed significantly for life expectancy, adult literacy and daily calorie supply over the past 30 years (see table). A relatively new and disturbing trend, however, is a widening gap between the least developed countries (LDCs) and other developing countries. For example, LDCs have experienced the smallest gains since the 1970s in critical indicators relating to child health and school enrolment.[6]

167. Debate over inequalities between men and women - their earning power, levels of education, personal security, political rights and access to social services - has surged in recent years. Historical data are weak, but it appears that, while a higher proportion of women in most regions of the world are now entering all levels of education, their participation in paid economic activity has risen very little in developing countries and has declined in LDCs.[7] Representation of women in politics and administration remains low in almost all countries.

Looking ahead: the policy challenges

168. Quantitative, integrated forecasts regarding the effects of economic growth on human development remain beyond the capacity of current models. The quality of growth is as important as quantity; government intervention, the uses of technology and cultural factors play a major role in determining the extent to which growth will generate employment, encourage participation in society and improve the quality of life for the many or the few. While the interaction of such complex factors cannot be precisely modelled, much experience has been gained over recent decades regarding policy approaches favourable to economic growth and human development.

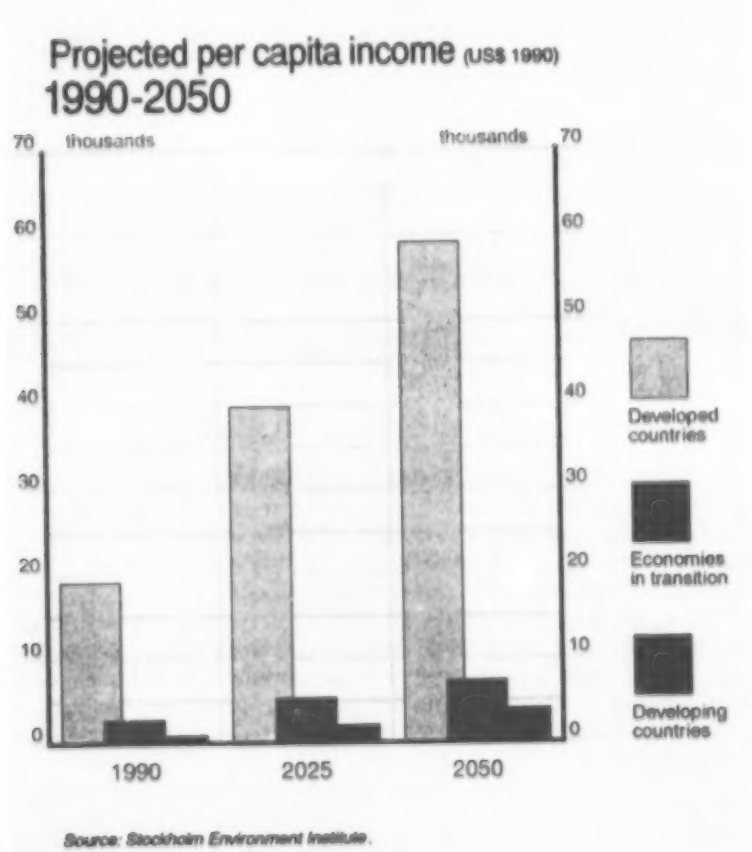
Eradicating poverty

169. No country has achieved permanent reductions in poverty without sustained economic growth, which stimulates demand, generates employment and provides the financial resources essential for government investment in basic social and other services.

170. Quantitative projections of global and regional growth tend to be short term and limited in their assessment of alternative patterns of government spending or private investment decisions. The Conventional Development Scenario projects economic growth rates for the period 1990-2050 of about 2 per cent for the OECD economies, and about 3 per cent for the developing countries. Developing countries are expected, over time, to evolve economic structures broadly similar to those of the industrialized world, shifting from agriculture towards industry and services.

171. By 2025, per capita income (in 1990 dollars) in the developed countries would double to $40,000, while in the developing countries average per capita income would treble to around $5,000. Such a development path would cause the income gap between the developed and developing world to narrow only slightly in relative terms, and to increase in absolute terms.

Figure VI.7



Source: Stockholm Environment Institute.

172. Faster rates of growth in the least developed countries are an urgent development priority. The factors contributing to sustained, broad-based growth are complex but include appropriate macroeconomic and sectoral policies, adequate investment in infrastructure and in essential sectors such as agriculture, health and education, as well as well-functioning institutions and good governance. The worldwide trend towards freer markets, private enterprise and trade offers new opportunities for reform and growth. The spread of democratic institutions and affordable communication technology will reinforce these developments.

Reducing inequity

173. While the majority of the world's population grows richer, the poorest 20 per cent - over 1 billion people - are so poor that they are effectively excluded from almost every benefit of modern society. This situation is not only unjust. It increasingly threatens, through waste of human resources, population movements and, in some regions, escalating crime rates, to undermine social stability and future economic growth. Economic and cultural globalization is encouraging the spillover of such poverty-related impacts from developing to developed countries. Nor is inequity confined to the developing world. Some richer countries now face the financial and social difficulties of coping with a growing "underclass" of disaffected citizens too poorly educated and too poor to participate in society.

174. Many countries have achieved high rates of economic growth alongside growing income disparities, and conventional wisdom has held that rapid growth and greater income equality are incompatible policy goals, at least in the early stages of industrialization. However, recent experience appears to indicate that more even distribution of private and public assets is no impediment to growth and may encourage faster, and more sustained, rises in prosperity. For example, the East Asian economies (excluding China) experienced annual per capita growth of 7.6 per cent between 1960 and 1993, with relatively low inequality.[3] Countries that have combined rapid economic growth with declining inequality have achieved dramatic reductions in poverty.[9]

175. Reducing the worst inequities will depend on (i) international and national action to reverse the stagnant or negative economic growth patterns currently experienced in the lowest income countries; and (ii) domestic policies (in all countries) which enable all sectors of society to benefit from growth.

176. Net flows of official development assistance (ODA) from the industrialized countries, on which the least developed countries in particular depend, have declined in real terms since 1994. Net capital flows of private direct investment, portfolio investment and commercial bank lending, however, have increased since 1992, though they have been concentrated in a small number of countries. While developed countries should honour their commitments to allocate 0.7 per cent of GNP to ODA, especially in the case of the least developed countries, the greatest long-term flow of resources appears likely to come from the private sector. Many developing countries will benefit from macroeconomic reforms favourable to inward investment and social policies which ensure that the benefits of new growth provide increased opportunities at all levels of society.

177. The burden of private and public debt accumulated by many developing countries in the 1970s has limited their economic growth and human development significantly. On the positive side, the debt-to-export ratio (the main indicator of an economy's ability to repay its debt) of most middle-income developing countries has substantially improved since 1992. Debt problems have been alleviated by a combination of sound economic policies, rescheduling of external debt and the introduction of new instruments such as debt conversion programmes. However, the level of indebtedness of some of the least developed countries remains so high as to constitute an almost insurmountable obstacle to development. Accelerated measures to reduce their debt burdens would seem an urgent priority to reignite growth in these countries.

Investing in human resources

178. Recent studies by the World Bank[10] conclude that human resources (raw labour, the returns on education and social organization) are overwhelmingly the dominant factor in the wealth of most countries, constituting some 76 per cent of wealth in North America, about 75 to 78 per cent in Latin America, about 78 per cent in East Asia, 65 per cent in South Asia and from 69 to 71 per cent in Africa. By contrast, produced assets (physical infrastructure, manufacturing plant) account for less than 15 per cent of wealth in many developing regions, only 20 per cent in North America and 28 per cent in Western Europe.

179. While the new global economy allows national Governments less autonomy in macroeconomic decision-making than in the past, their scope for influencing human development through public investment and institutional reform remains considerable. Investment in human resources, in the form of public and private expenditures on education, health and other services, appears to bring the greatest returns on capital, thus promoting more rapid growth in GDP while also alleviating poverty.

180. The percentage of public expenditure devoted to social sectors, however, varies greatly across countries, even those at similar income levels. Many developing countries, particularly in Africa and the Middle East, have invested heavily in education in recent years. However, for developing countries as a whole, public expenditure on education as a percentage of GNP barely changed between 1980 and 1992, rising from 3.8 to 3.9 per cent.[11] This compares with a figure of 5.4 per cent in industrialized countries. Nearly two thirds of the world's illiterate adults are still women, most of them living in the developing regions of Africa, Asia and Latin America; given their central role in development, improvement of women's educational status should remain a clear priority.

181. Spending on health remains low, at 2 per cent of GDP in developing countries and only 1.8 per cent in the least developed countries, compared with over 6 per cent in industrialized countries.[12] Finance for health and education in most industrialized countries is also significantly augmented by private investment. According the World Health Organization, the most urgent health priority today is to complete the final stages of eradicating those infectious diseases which are now in decline but could revive sharply if efforts slacken. In the longer term, broader socio-economic development remains the key to

providing adequate health services and enabling the poor to protect themselves from health hazards.

182. A key factor in the quality of, and access to, social services is thus the distributional impact of government spending. Many studies now document the economic and wider social benefits of investment in basic education and primary health care. Subsidies for education, health, water and energy supplies in many countries, however, can be highly regressive, benefiting relatively wealthy users at the expense of the poor. For example, the urban poor in developing countries tend to live in slum areas where they must rely on pri ate water vendors, paying an average of 12 times the amount paid by wealthier householders for subsidized municipal water.[13] Higher education institutions and large modern hospitals, used by the relatively prosperous few, often claim a disproportionate share of limited education and health budgets.

183. The World Summit for Social Development (Copenhagen, 1995) and follow-up processes have recognized the priority of improving access and quality of basic social services in eradicating poverty. The "20/20 initiative" seeks to increase funds for social investment through reciprocal agreements in which developed and developing country partners allocate 20 per cent of ODA and 20 per cent of national budgets respectively to basic social services by the year 2000.[14] Implementation of this commitment would represent a significant step forward. Developed countries will also need to commit greater resources, both public and private, to education, if their populations are to develop the skills necessary to function well in more complex, technical and competitive societies.

Managing the natural resource base

184. While natural capital may not equal the importance of human resources and produced assets in development (see above), it remains a critical component of national wealth. Natural resources such as soil and water are part of the earth's life support system and, if destroyed, cannot be replaced (with rare exceptions, and at high cost). In addition, natural capital assumes far greater importance in the wealth of lower-income countries, representing up to 20 per cent of national wealth in low-income economies with a heavy reliance on natural resource exports.[15] Agricultural land is the dominant form of natural capital in these countries; damage to productive soil and water therefore threatens both the immediate livelihood of rural populations and erodes the factors of production which should underpin the transition from an agricultural/rural to an industrial economy.

185. Many studies now document the association between environmental degradation and poverty, though other factors are also involved.[16] In many parts of Latin America, Asia and Africa, poor farmers are often forced on to marginal lands by unequal land distribution, lack of secure land tenure, marginalization of small-scale agriculture by cash-crop operations, conversion of land to other uses and population growth. National circumstances vary too widely for any single approach to rural development to prove effective, but critical policy reforms appear to include measures to improve land tenure, expand access to credit and technology and reduce tax burdens on rural producers that limit investment in smallholder agriculture and rural enterprises. Recent comprehensive studies of

the economic effects of agricultural policies in developed and developing countries conclude that the net tax (export taxes over input subsidies) on agriculture in low and lower-middle income countries in 1990 may have exceeded $130 billion - nearly equal but opposite to the producer subsidy in OECD countries.[17]

186. An equally critical issue for human development in developing countries concerns the investment of revenues from exploitation of natural resources such as timber and minerals. Natural resource endowments can be transformed into other productive assets that boost incomes and growth. Or they can be dissipated, the revenues used for consumer goods or debt repayment. In the latter case, resource exploitation becomes unsustainable, since there is an ongoing net loss of national wealth.

187. The concept of "genuine savings" is being increasingly promoted as a means of defining the true rate of saving (or economic sustainability) in a country - a measure based on standard national accounting, modified such that natural resource depletion and pollution damage decrease the rate of saving, while investments in human capital (primarily educational expenditures) increase it. Calculation of average genuine saving rates over the past 25 years reveals distinct regional differences. High rates of saving are evident in the East Asia/Pacific region and the high-income OECD countries. Strongly negative rates of saving are apparent in two categories of country - those which became heavily indebted following the oil crises, and the oil-rich countries which failed to invest their windfall profits adequately for future growth.[10]

188. Improved rent capture (collection of royalties on resource use) by Government, and reinvestment of those rents, are thus crucial policy priorities in many low- and middle-income countries. Without sufficient rent capture, there is a strong incentive for producers to over-exploit and degrade natural resources. Without investment, wealth is dissipated and opportunities for development squandered. And the highest quality form of public expenditure is, for many countries, in human resources. If there is a key to achieving growth, development and sustainability, it may lie in the transformation of perceptions surrounding spending on social services; such spending represents, not a cost, but the surest investment for the future.

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VII. CONCLUSIONS

Historical trends

189. Any review of global change is subject to the problem of conflicting interpretations, even when based on identical data sets. Many trends may be seen as positive or negative according to the perspective of the reviewer and the indicators selected. For example, energy intensity has fallen but consumption has risen, the percentage of people living in poverty has fallen but absolute numbers have grown, per capita emissions of some pollutants have fallen relative to GDP while their total emissions have risen. "Optimistic" or "pessimistic" characterizations of the past and projections of the future are therefore dependent, at least in part, on social and individual perceptions.

A more qualitative assessment of recent decades reveals some broad, but clear, trends in the economic, social and environmental spheres of development

190. Socio-economic development in many middle- and higher-income developing countries appears to be following the same "family of transitions" (see chap. I) experienced in the developed world, albeit at a faster pace. Where the industrialized countries have developed stable populations and mature - though still changing - economies, much of the developing world is in a rapid growth phase. Per capita incomes are rising with industrialization, consumption of energy, goods and services is growing, and levels of education and health are generally improving. Capitalism and consumerism show every sign of remaining dominant forces in an increasingly homogeneous world culture.

191. Despite record rates of global economic growth, wealth disparities have increased between the rich, developed countries and the developing world; differentiation is also becoming more apparent between more successful developing countries and those which remain least developed. The phenomenon of marginalization, whereby the poorest countries fail to achieve economic or social "take-off" and become progressively less able to participate in the global economic system, has become sharply apparent since the 1980s. Their populations continue to grow, as do poverty, environmental degradation and declining quality of life.

192. Environmental quality with respect to air and fresh water has generally improved in the developed world but is still worsening in many areas of newly industrializing regions. A major preoccupation of the 1970s, the threat of exhaustion of non-renewable resources, now appears less urgent and environmental concerns have shifted to the degradation of renewable resources, primarily soil, forests, water and the atmosphere. The extent and/or quality of these resources, and of other natural habitats and biodiversity, has declined overall in many regions of the world.

Future prospects

193. Many goals relating to human development and environmental protection that were established during the 1960s and 1970s have been reaffirmed in the international conferences of the 1990s - indicating that they have yet to be

achieved. Notable examples include the eradication of poverty, hunger, illiteracy and discrimination, and the protection of certain threatened natural resources, habitats and species. The prospects for achieving more sustainable patterns of development in the coming decades appear mixed.

Trends and projections in a number of key issues are cause for serious concern

194. The persistence of current trends in a number of critical issues, according to the Conventional Development Scenario and other leading "business-as-usual" projections, will lead to continuing poverty and declining quality of life in some developing regions, especially in urban areas, increasing competition over use rights to natural resources and worsening environmental degradation.

195. Persistent and growing poverty is undermining socio-economic development in many regions of the world. In some countries, social disaffection fuelled by gross inequity is hindering the ability of Governments to govern and the private sector to conduct business. Social impoverishment is also felt more widely: the financial and quality of life costs to people who, though not poor themselves, live in divided societies, are only now beginning to be measured. Per capita incomes in developing countries are not closing the gap with developed countries in absolute terms; income disparities within countries are also growing.

196. Population growth and urbanization are often most rapid in low-income developing countries which lack the resources to provide infrastructure and basic social services necessary to promote employment, health and economic growth. Population growth, in combination with rural poverty and insecure land tenure systems, is a factor in deforestation and soil degradation. Urban population growth, from rural-urban migration and natural increase, will place an unprecedented logistical and financial burden on municipal authorities, especially in the least developed countries.

197. Fossil fuel consumption in industrialized countries is slowly stabilizing but many polluting emissions continue to rise, especially carbon dioxide emissions responsible for global warming. Rapid economic growth in many developing countries is leading to severe environmental pollution at local and regional levels and poorly quantified damage to human health. Energy consumption is projected to approximately double by 2050.

198. Rapid and continuous degradation of the natural resource base, on which economic activity and life itself depend, may constitute the most serious of all threats to human well-being in the future. Contamination of fresh water supplies and destruction of productive soil, fisheries and forests reduce the wealth base of countries and thus their prospects for future development. Substitution of lost resources (for example, through food imports or water purification facilities) imposes additional financial burdens on Governments. And declining resource availability, especially in combination with rising population numbers, leads to increased competition, social dislocation and potential conflict. Resource degradation is of greatest consequence in lower-income developing countries which may not have the financial, technological or institutional capacity to reorient their economies to a "natural resource-poor" structure in the timespan available.

Other trends have the potential to bring about more sustainable patterns of development

199. Against this picture must be set many positive developments, especially the socio-economic progress made in many developing countries over the past 30 years. Many developing regions are undergoing the demographic, economic and social transitions much more rapidly than was the case in the industrialized countries. It may be expected, therefore, that many of the technological, social and environmental improvements that are evident in the mature economies of developed countries will follow, again more rapidly, in developing countries.

200. Fertility rates are declining more rapidly than anticipated in most world regions. World population projections have been revised downward throughout the 1990s and many developing countries can now plan for a stabilizing population within the next generation or two. High rates of population increase persist in a number of countries, however, and are cause for concern where natural resources (agricultural land, forests, fisheries) are still an important source of national wealth.

201. Education and health have improved significantly in developing countries, in some cases dramatically. Healthy, educated populations are of prime importance in economic growth and social development and these improvements, if continued, will be instrumental in creating demand for, and contributing to, more sustainable decision-making in all areas of life.

202. In addition, a number of broader global trends are apparent which, though neutral in themselves, provide a context favourable to the achievement of sustainable development if Governments, and societies, choose to take advantage of them.

203. Economic forecasts are positive for most world regions. Many indicators of human welfare in developing countries may be expected to rise in line with income growth as they have done historically. Economic growth will also make available additional resources for environmental clean-up and protection needed to maintain natural capital at adequate levels. Nevertheless, the pace and scale of pollution and resource degradation in some developing countries is such that they are likely to incur very high costs in terms of health care, environmental remediation and substitution of damaged resources. This implies the need for increased investment in pollution prevention measures which, though initially costly, are far cheaper than clean-up.

204. Technological innovation continues to accelerate, often in response to the implementation of effective policy incentives. Significant improvements in living standards and the efficiency and safety of economic activity could be achieved through more effective deployment of existing technologies. Further decarbonization of the energy supply, increased productivity of agricultural land, greater efficiency of water and materials use may all be expected with some confidence. The more these processes are accelerated through policy incentives, the greater the social and environmental benefits are likely to be. The potential for more radical economic and social transformation, through entirely new technologies, is unknowable but cannot be dismissed for the longer term.

205. The spread of democratic institutions and rising levels of education are encouraging greater public participation in decision-making. Community groups and non-governmental organizations in developed and developing countries are demonstrating their ability to manage local problems of resource scarcity or develop successful responses to social and environmental challenges. Such activities augment "social capital" and generate the human ingenuity which, together with technology, is an essential input to problem-solving. Limited government resources are reinforcing this trend, as central Governments in both developed and developing countries experiment with partnership arrangements and increased devolvement of government responsibilities to non-governmental actors.

The impact of policy

Policy intervention has had a clear and positive effect on a number of trends

206. The high standards of public health and education in developed countries can be attributed largely to early State provision of water and sanitation services, health-care systems and universal schooling. The more recent, rapid falls in infant, child and maternal mortality rates in most developing countries and the eradication of a number of killer diseases are the result of targeted campaigns organized by national Governments and international agencies. Adult literacy rates in the developing world have also responded to government investment in education.

207. The slowdown in the rate of the world's population growth has many and complex causes, but government population programmes, involving education, child health care and access to family planning services, have demonstrably contributed to falling fertility rates.

208. The numbers of malnourished people in the world remain high, but would undoubtedly be far higher had it not been for national and international policy commitment to develop and introduce more productive crop varieties and improved agricultural management techniques. The "Green Revolution" of the 1950s and 1960s was the product of intensive, Government-backed research and development.

209. Industrial pollution of air and water has been dramatically reduced in many developed countries. While part of the decline is accounted for by market-driven technological change, the process has been accelerated by government regulations which have progressively tightened emission standards, technical specifications and ambient quality targets.

But other trends have resisted policy intervention - or have barely been tackled

210. Macroeconomic policies to promote growth and development, and targeted attempts to help the poor, have not succeeded in eradicating poverty, only in slowing its rate of growth. The distribution of the world's wealth has become steadily more inequitable, in part because overtly redistributional policies are so politically sensitive.

211. The numbers of people without access to basic energy, water and sanitation services continue to rise. Despite major investments, State provision has failed to keep pace with population growth and urbanization.

212. The rate of natural resource degradation is accelerating in many regions of the world. In large measure, this can be attributed to the malign influence of policy: ineffective or preferential land and water use policies, distortionary pricing signals and inappropriate investment decisions.

213. Common characteristics of these failures include lack of financial resources and institutional capacity in many developing countries, and political unwillingness - in all countries - to reform traditional property rights and fiscal policies. A further factor in the widespread failure to protect land and water resources is the dispersed and incremental nature of damage, which diminishes the perceived impact on the total resource base.

Priority strategies

214. Policy has a significant role to play in promoting economic development, social equity, stable, educated and healthy populations, well-managed natural resources and a clean environment. These factors are key indicators of what might be termed "successful" transitions, and of sustainable development. Achieving these goals is likely to depend on accelerating, not retarding, the pace of global change. Developing countries must go through the process of population stabilization and socio-economic development in order to attain decent living standards; the more these transitions are prolonged, the greater will be the economic, social and environmental costs. At the same time, cleaner and more efficient development pathways must be found if economic and social development is not to be frustrated by the destruction of natural resources.

Three strategies represent promising policy approaches

215. Increased investment in people, through spending on social services, especially basic education and health care, is essential (chaps. II and VI). In addition to the benefits for GNP growth, an educated, healthy population strengthens the capacity of society to manage problems and withstand external shocks. The multiple challenges of creating or maintaining economic growth while minimizing damage to the natural environment are too great to be managed by Governments alone. Empowerment of people, through greater political and economic independence and access to information, enables local communities, organizations and business to contribute to effective solutions.

216. The encouragement of clean and efficient technologies, through regulatory requirements and economic incentives, serves two key objectives. Efficiency and productivity gains usually represent the quickest and cheapest way to "expand" both non-renewable and renewable resources (chaps. III-V). Efficient and clean technologies are cost effective and reduce the need for government expenditures. For example, energy saving can reduce the need for oil imports, and pollution control reduces environmental clean-up and health care costs - now reaching billions of dollars in the developed world.

217. Pricing reform which begins to internalize the social and environmental costs of key economic activities is critical if more sustainable use of natural resources is to be achieved. Current market distortions too often encourage (or force) short-term, wasteful and destructive consumption patterns (chaps. III-V). The imposition of new taxes and the phase-out of subsidies are fraught with political difficulty; changing incentive structures inevitably creates losers, sometimes among powerful interest groups. The challenge is therefore to experiment with fiscally neutral reforms which bring about change on an incremental basis.

218. Positive developments are evident in each of these areas but the pace of change is slow. Investment in human resources is increasing but tends to lack priority relative to the traditional productive sectors of the economy. Technological efficiency is constantly improving but innovation, and wider deployment, must be speeded up in order to have a serious impact on global levels of productivity and pollution - efficiency gains so far this century have been more than offset by the volume of economic growth. Reversing degradation of natural resources will take decades and delaying necessary reforms will greatly increase the monetary and human costs involved.

219. The goal of sustainable development should serve, in practice, as a wake-up call: to use and share the existing capabilities.